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Japan

MAJOR INDICES OF JAPANESE R&D ACTIVITY

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93FE0042A Tokyo AGENCY OF INDUSTRIAL SCIENCE AND TECHNOLOGY in Japanese Jun 92
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Major Indices of Japanese R&D Activity

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[Text] **About This Data**

1. In principal, the chart data in this report is limited to natural science categories, except in the case of international comparisons. When data that is only in the category of natural science is used, "natural science only" is noted in the title of the chart. When aggregate data for natural science, humanities, and social science is used, "natural science + humanities and social science" is noted in the title of the chart.

2. The primary source of data for this report, "Survey Report of S&T Research," has been published since 1953. Those reports are the results of surveys of statistics designated according to the Statistics Act (No. 61); the purpose of the surveys is to "ascertain the state of research activities related to Japan's S&T, and to provide the basic materials needed to promote S&T."

3. The following table gives the exchange rates for the currencies of the principal countries in this report.

Country Year	U.S. ¥/$	Germany ¥/Mark	France ¥/Franc	U.K. ¥/£	USSR ¥/Ruble
1970	358.1	98.20	64.78	857.9	397.9
1971	349.3	100.07	63.03	850.4	421.4
1972	303.2	95.08	60.04	758.5	369.7
1973	271.7	101.66	60.95	666.3	360.3
1974	292.1	112.87	60.67	683.2	400.1
1975	296.8	120.63	69.24	659.4	391.5
1976	296.6	117.77	62.05	535.6	396.5
1977	268.5	115.63	54.65	468.7	359.9
1978	210.4	104.77	46.63	403.9	318.8
1979	219.1	119.56	51.51	464.9	337.1
1980	226.7	124.74	53.66	527.5	343.5
1981	220.5	97.58	40.58	447.2	306.3
1982	249.1	102.65	37.90	436.0	341.2
1983	237.5	93.02	31.16	360.3	308.5
1984	237.5	83.46	27.18	317.4	279.4
1985	238.5	81.03	26.55	309.2	309.8
1986	168.5	77.61	24.33	247.2	246.4
1987	144.6	80.47	24.06	237.1	240.3
1988	128.2	72.97	21.51	228.3	209.4
1989	138.0	73.38	21.62	226.2	217.9
1990	144.8	89.61	26.59	258.4	—

Note: For the yen-to-dollar exchange rates on which the yen conversions are based, we use the yearly average value that the yen sold for on the Tokyo Market.

Sources: IMF "International Financial Statistics," but for the USSR, the U.N. "Monthly Bulletin of Statistics." (Quoted from the S&T White Paper)

4. The yen conversion rates based on purchasing power parity that are used in Chart 1-2 (the reference chart) are given below. These rates are computed by using price standards and so forth to compare the purchasing power of each country's currency.

Country / Year	U.S. ¥/$	Germany ¥/Mark	France ¥/Franc	U.K. ¥/£
1970	256	77.8	53.7	892
1971	257	76.0	53.3	860
1972	259	76.0	52.5	835
1973	274	80.6	54.6	884
1974	304	91.0	59.0	930
1975	298	92.5	56.3	788
1976	300	95.5	54.2	733
1977	298	97.7	52.7	682
1978	291	98.3	50.1	642
1979	275	97.2	46.8	578
1980	262	96.3	43.7	502
1981	247	95.7	40.5	465
1982	236	93.3	36.9	439
1983	230	90.9	33.8	421
1984	225	90.4	31.9	408
1985	222	89.5	30.5	391
1986	221	88.4	29.5	384
1987	214	86.3	28.6	365
1988	208	85.2	27.8	343
1989	204	84.6	27.3	327
1990	200	83.7	27.0	315

Source: OECD "Main Economic Indicators," "National Accounts" (Quoted from the S&T White Paper)

5. The tables below show how this report's classifications as industry, government, or universities (A), and the classifications as government or private sector (B), correspond to the organizations mentioned in the "Survey Report of S&T Research.

1. Classification as research body (that which receives/uses research outlays)

This report		Survey report of S&T research
A	Industry	Companies Special corporations Privately run research organizations
	Universities	National universities Prefectural universities Private universities
	Government	Government-run research organizations Municipally run research organizations Special corporations
B	Government	Government-run research organizations Municipally run research organizations Special corporations National universities Prefectural universities
	Private sector	Companies Special corporations Privately run research organizations Private universities

A: Classification as industry, government, or universities
B: Classification as government or private sector

2. Classification as source of research outlays (that which disburses research outlays)

This report		Survey report of S&T research
A	Industry	Internal (the research body itself) and external Special corporations that are public or semi-governmental companies Private companies Privately run research organizations Other
	Universities	Internal (the research body itself) and external National, prefectural universities Private universities
	Government	Internal (the research body itself) and external The government Regional public bodies National, prefectural universities Research organizations run by government or by prefectures Other private organizations Special corporations that are research institutes, business groups, etc.
B	Government	Internal (the research body itself) and external The government Regional public bodies National, prefectural universities Research organizations run by government or by prefectures Other national or regional public bodies Special corporations that are research institutes, business groups, etc.
	Private sector	Internal (the research body itself) and external Special corporations that are public or semigovernmental companies Private companies Privately run research organizations Private universities Other private organizations

List of Charts and Tables

1. Macro R&D Trends

Chart 1-1 Change in Japan's Research Outlays

Japan's outlays in FY90 for research in natural science amounted to a total of about ¥12.9 trillion, showing a 10.8% increase over the year before. Private-sector research outlays increased 12.0%, which is more than the government's 4.6% increase. Research outlays were 2.77% of the GNP.

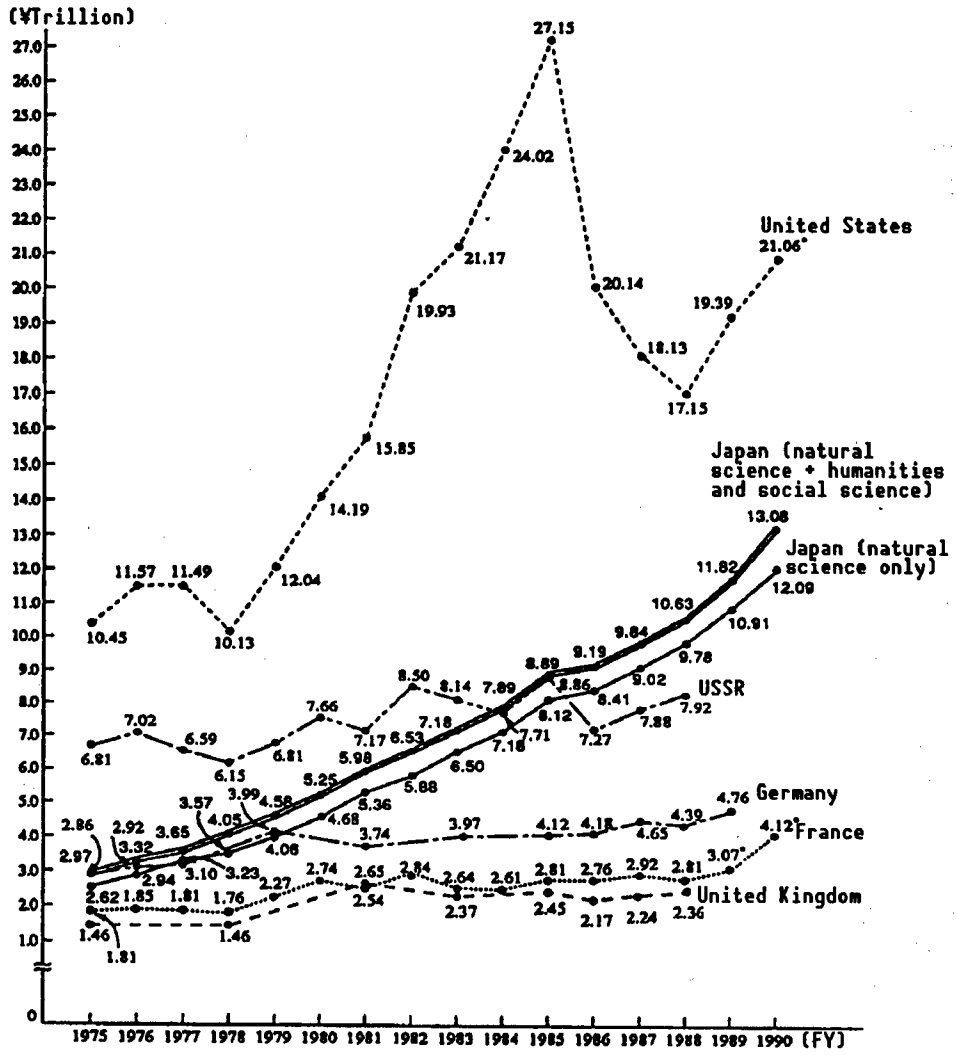
(Unit: 100 million yen)

Item \ Fiscal Year		1980	81	82	83	84	85	86	87	88	89	90
Total outlays[1]		52,642	59,824	65,287	71,808	78,939	88,903	91,929	98,366	106,276	118,155	130,783
		(14.5)	(14.0)	(9.1)	(10.0)	(9.9)	(12.6)	(3.4)	(7.0)	(8.0)	(11.2)	(10.7)
Outlays[2]	Total	46,838	53,640	58,815	65,037	71,765	81,146	84,150	90,162	97,752	109,093	120,896
		(15.3)	(14.5)	(9.6)	(10.6)	(10.3)	(13.1)	(3.7)	(7.1)	(8.4)	(11.6)	(10.8)
	Government	10,982	11,860	12,271	12,799	13,388	14,301	14,809	16,359	16,421	17,018	17,805
		(7.8)	(8.0)	(3.5)	(4.1)	(4.8)	(6.8)	(3.6)	(10.5)	(0.4)	(3.6)	(4.6)
	Private sector	35,856	41,780	46,544	52,258	58,378	66,863	69,341	73,803	81,331	92,075	103,091
		(17.8)	(16.5)	(11.4)	(12.3)	(11.7)	(14.5)	(3.7)	(6.4)	(10.2)	(13.2)	(12.0)
	Firms	31,423	36,298	40,390	45,601	51,366	59,399	61,202	64,943	72,193	82,338	92,672
		(17.9)	(15.5)	(11.3)	(12.9)	(12.6)	(15.6)	(3.0)	(6.1)	(11.2)	(14.1)	(12.6)
Nominal GNP		2,453,600	2,603,343	2,738,072	2,856,515	3,057,253	3,253,705	3,396,853	3,562,636	3,792,300	4,060,129	4,369,275
		(8.9)	(6.1)	(5.2)	(4.3)	(7.0)	(6.4)	(4.4)	(4.9)	(6.4)	(7.1)	(7.6)
Total outlays[1] / Nominal GNP (%)		2.14	2.30	2.38	2.51	2.58	2.73	2.71	2.76	2.80	2.91	2.99
		(5.4)	(7.5)	(3.5)	(5.5)	(2.8)	(5.8)	(-0.7)	(1.8)	(1.4)	(2.1)	(2.7)
Total outlays[2] / Nominal GNP (%)		1.91	2.06	2.15	2.28	2.35	2.49	2.48	2.53	2.58	2.69	2.77
		(6.1)	(7.9)	(4.4)	(6.0)	(3.1)	(6.0)	(-0.4)	(2.0)	(2.0)	(2.7)	(3.0)
Total real research outlays[1]		57,591	63,539	67,530	73,672	79,223	88,903	93,850	99,706	105,269	112,241	120,357
		(6.1)	(10.3)	(6.3)	(9.1)	(7.5)	(12.2)	(5.6)	(6.2)	(5.6)	(6.6)	(7.2)
Total real research outlays[2]		50,966	56,582	60,510	66,500	71,909	81,164	86,131	91,721	97,265	104,097	111,734
		(6.7)	(11.0)	(6.9)	(9.9)	(8.1)	(12.9)	(6.1)	(6.5)	(6.0)	(7.0)	(7.3)

Notes: [1] Including humanities and social sciences.
[2] Natural sciences.
The figures in parentheses show the rate of increase over the previous year.
"Outlays" indicates the research outlays that each organization used internally.
For nominal GNP, the FY85 standard value is used.

Chart 1-2 Change in Principal Countries' Research Outlays
Natural Science + Humanities and Social Science)

Japan's research outlays in FY90 totaled about ¥13.8 trillion. This is a scale that is second in the world, corresponding to 62% of the research outlays of the United States, which has the largest research outlays.

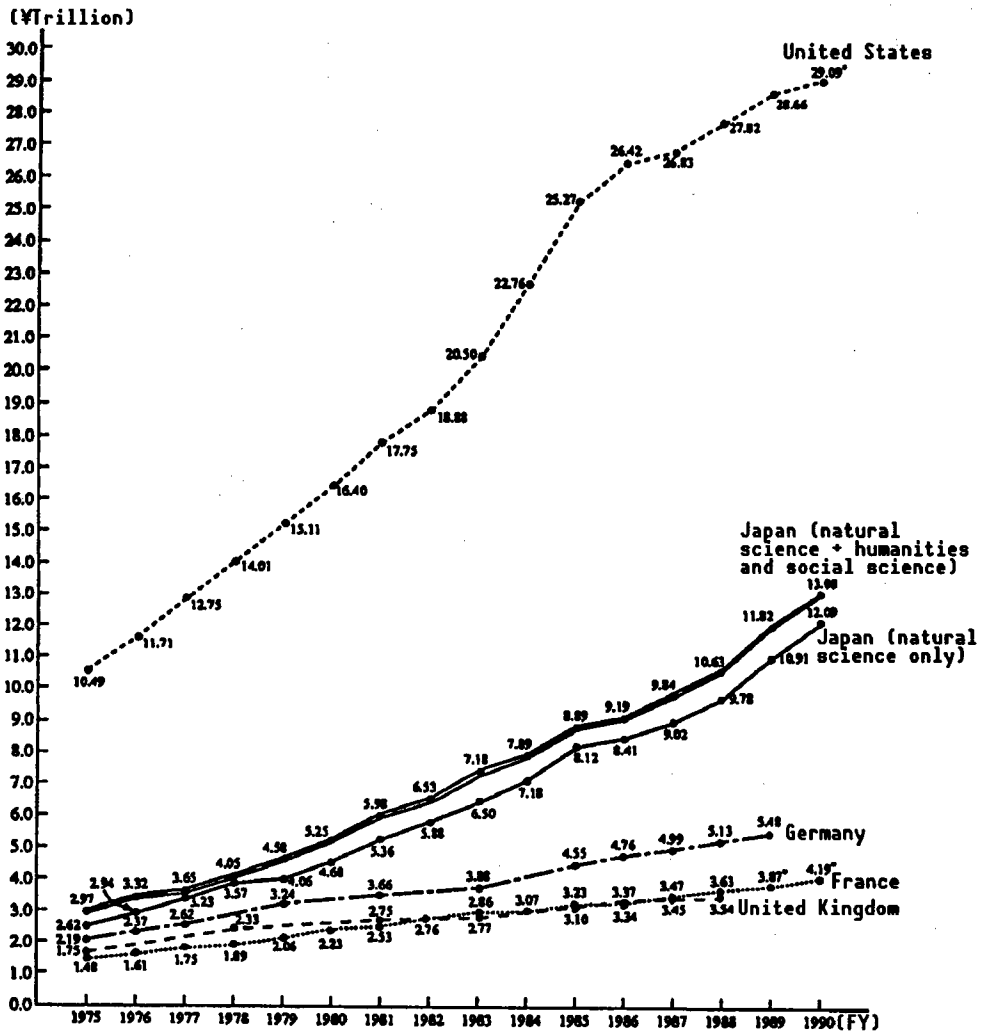


Notes: The data are totals for natural science, humanities and social science. The small blank circles indicate provisional values. Trial calculations of the data for Japan in FY90 using the OECD full-time equivalent give ¥12.25 trillion (for natural science, humanities, and social science) and ¥11.59 trillion (natural science only). (For details, see Reference Data 2.)

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: OECD (after 1985, Annual Review of Government Funded R&D)*
USSR: Annual Economic Statistics (Central Statistics Bureau)*

* Quoted from the S&T White Paper

Reference Chart Change in Principal Countries' Research Outlays
(Natural Science + Humanities and Social Science)
(Based on purchasing power parity)



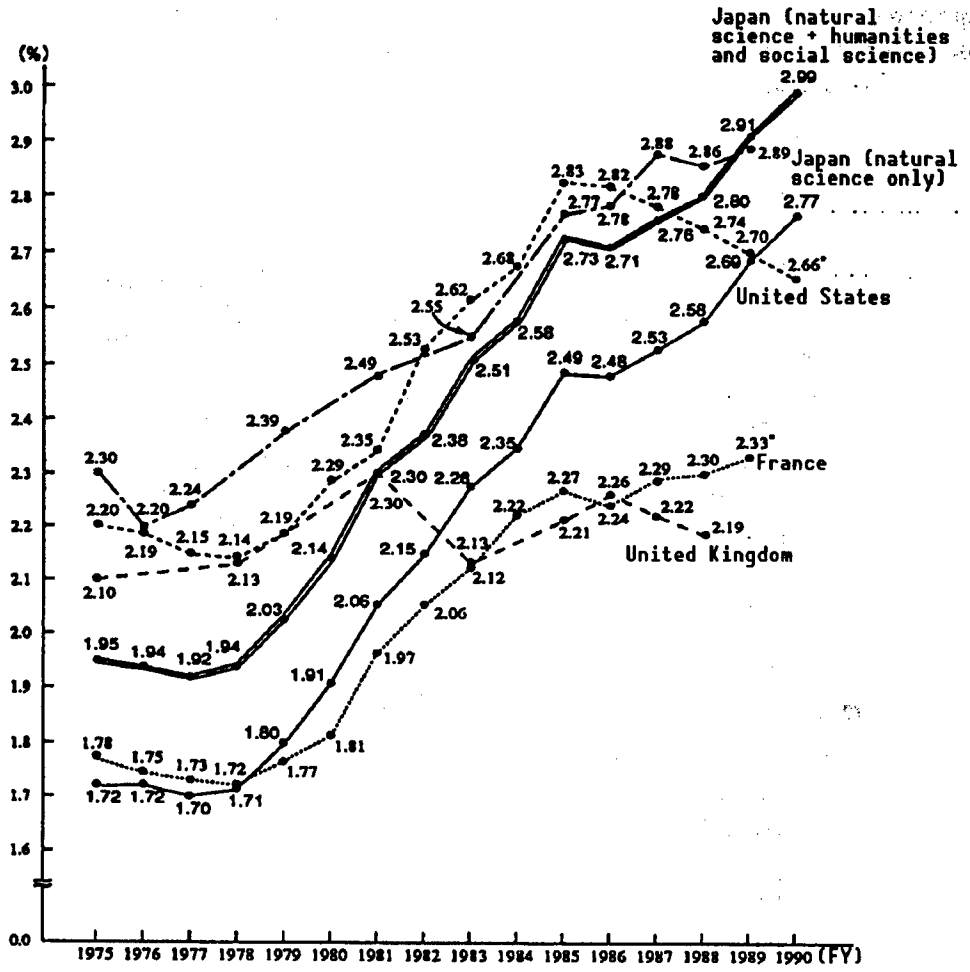
Notes: The data are totals for natural science, humanities and social science.
The small blank circles indicate provisional values.

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: OECD statistics (after 1985, Annual Review of Government Funded R&D)*

* Quoted from the S&T White Paper

Chart 1-3 Change in Research Outlays vs. GNP for Principal Countries (Natural Science + Humanities and Social Science)

Japan's research outlays as a percentage of GNP, at 2.99% (FY90), is in line with that of Germany and is assumed to be almost the highest level in the world.



Notes: The data are totals for natural science, humanities and social science. The small blank circles indicate provisional values. Trial calculations of the data for Japan in FY90 using the OECD full-time equivalent give values of 2.80% (for natural science, humanities, and social science) and 2.65% (natural science only). (For details, see Reference Data 2.)

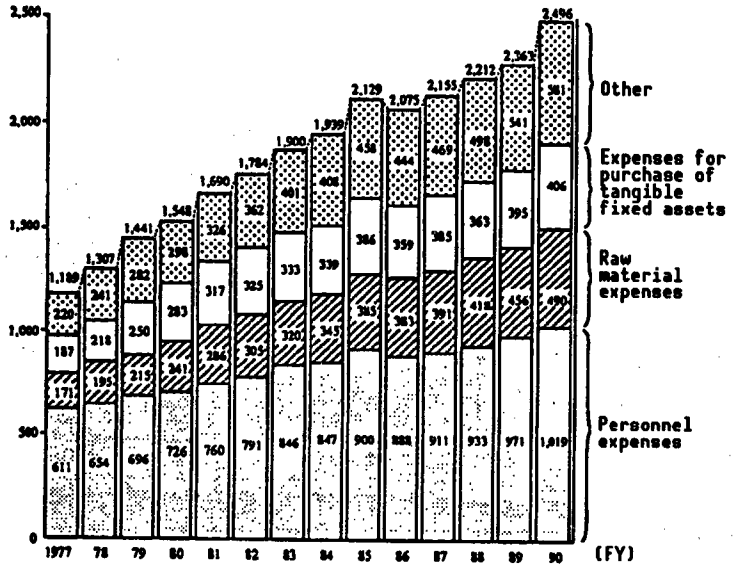
Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: OECD statistics (after 1985, Annual Review of Government Funded R&D)*

* Quoted from the S&T White Paper

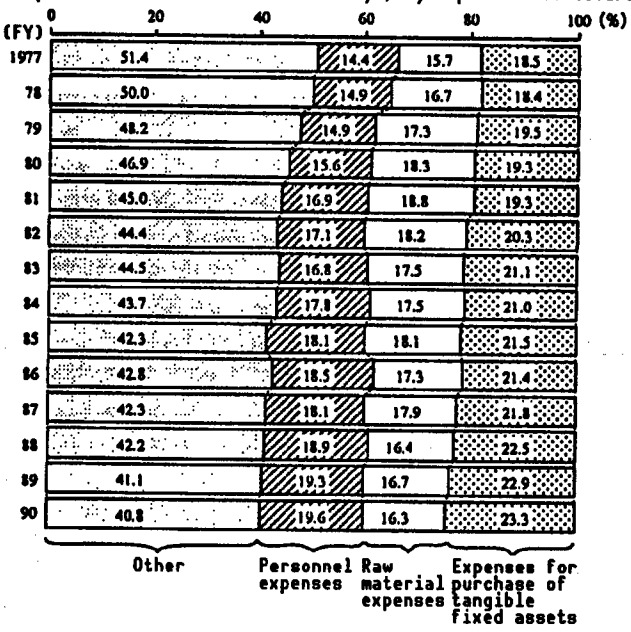
Chart 1-4 Japan's Research Outlays Per Full-Time Researcher (by Expense Item) (Natural Science)

Japan's research outlays per full-time researcher declined in FY86, but later continued to grow steadily. A look at the breakdown of research outlays by expense item shows that the percentage of outlays for raw materials and for other expenses is growing, from which it can be gathered that raw materials, obtaining information, etc., in research activities is increasingly important.

(1) Research outlays per full-time researcher (overall)



(2) Component ratios of research outlays, by expense item (overall)

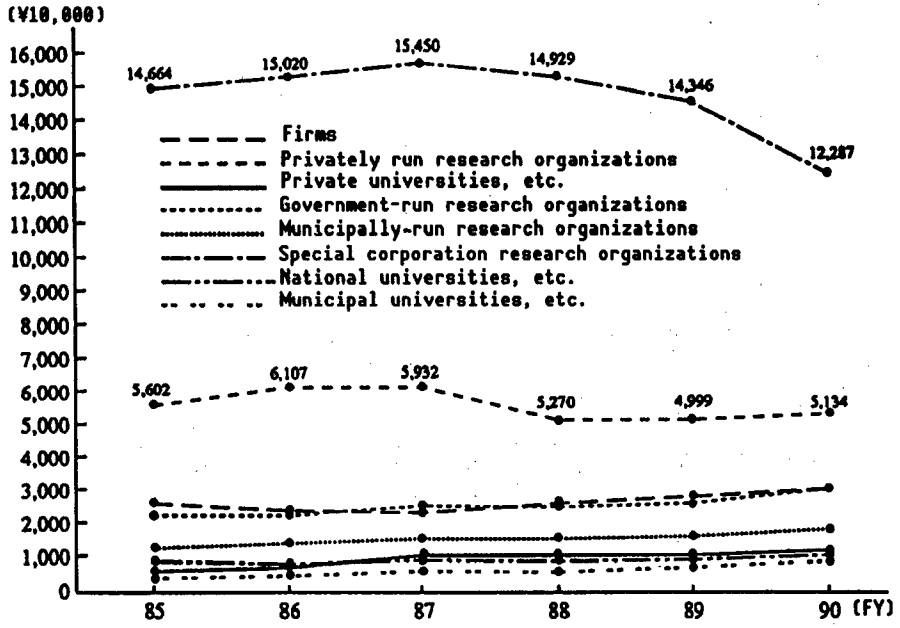


Note: For the number of full-time researchers, the data as of 1 April 1990 is used, for example, in the case of FY90.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 1-5 Japan's Research Outlays Per Full-Time Researcher (by Organization) (Natural Science)

Research outlays per full-time researcher in FY90 were ¥27.53 million in the private sector and ¥16.19 million in the government sector, with private-sector outlays about 1.7 times that of the government. By organization, special corporation research organizations put out about ¥120 million per researcher, significantly more than the other types of organizations.



Source: Survey Report of S&T Research (Management and Coordination Agency)

Reference Table Japan's Research Outlays Per Full-Time Researcher (by Organization) (Natural Science)

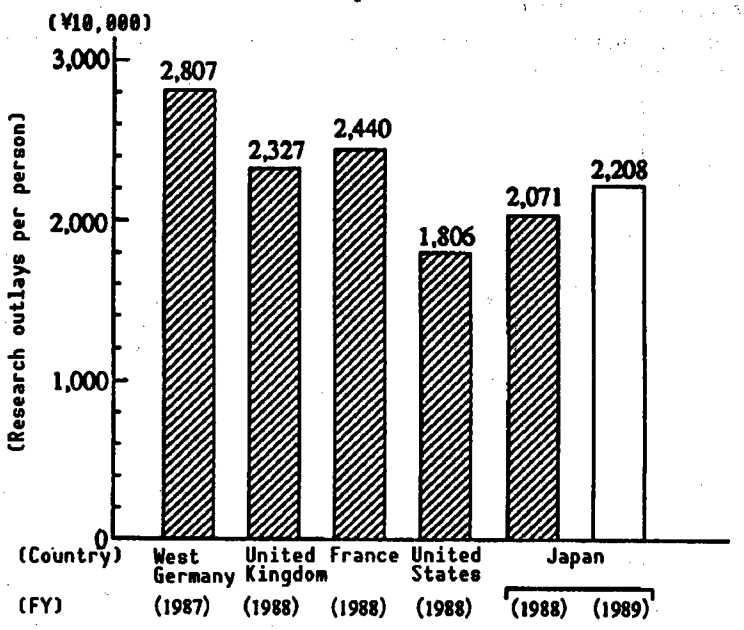
(Unit: ¥10,000)

Organization	FY85	FY86	FY87	FY88	FY89	FY90
Overall	2,129	2,075	2,155	2,212	2,363	2,496
Private sector	2,375	2,278	2,341	2,418	2,603	2,753
Firms	2,570	2,431	2,490	2,585	2,799	2,952
Privately-run research organizations	5,602	6,107	5,932	5,270	4,999	5,134
Private universities, etc.	961	971	1,023	1,020	1,049	1,107
Government	1,434	1,463	1,587	1,556	1,577	1,619
Government-run research organizations	2,266	2,328	2,943	2,576	2,671	3,014
Municipally-run research organizations	1,380	1,398	1,464	1,536	1,650	1,843
Special corporation research organizations	14,664	15,020	15,450	14,929	14,346	12,287
National universities, etc.	991	926	976	968	985	1,027
Municipal universities, "	654	660	690	681	790	901

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 1-6 Principal Countries' Research Outlays Per Full-Time Researcher (Natural Science + Humanities and Social Science)

Japan's research outlays per full-time researcher (¥22.08 million, FY89) are approaching the level of that in Europe and the United States.

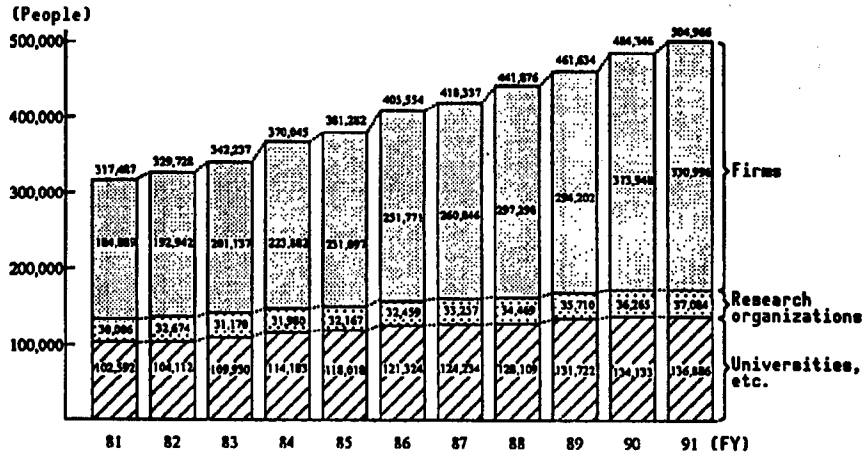


Notes: • For the United Kingdom, only natural science data are shown, but the data for the other countries are for natural science, humanities, and social science.
• For the United Kingdom, the data are for that within industry and government.
• Trial calculations of the data for Japan in FY88 and FY89 using the OECD full-time equivalent give values of ¥23.83 million (FY88) and ¥25.41 million (FY89). (For details, see Reference Data 2.)

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: Annual Review of Government Funded R&D*
* Quoted from the S&T White Paper

Chart 1-7 Change in Number of Full-Time Researchers in Japan (Natural Science + Humanities and Social Science)

The number of full-time natural science researchers in Japan as of 1 April 1991 was 550,000 (an increase of 4.3% over the previous year), indicating the same kind of steady growth that was seen up until that point. By organization, the number of researchers in firms is increasing most rapidly.



Note: The data for each year are as of 1 April.
Source: Survey Report of S&T Research (Management and Coordination Agency)

Reference Table Change in Number of Full-Time Researchers in Japan

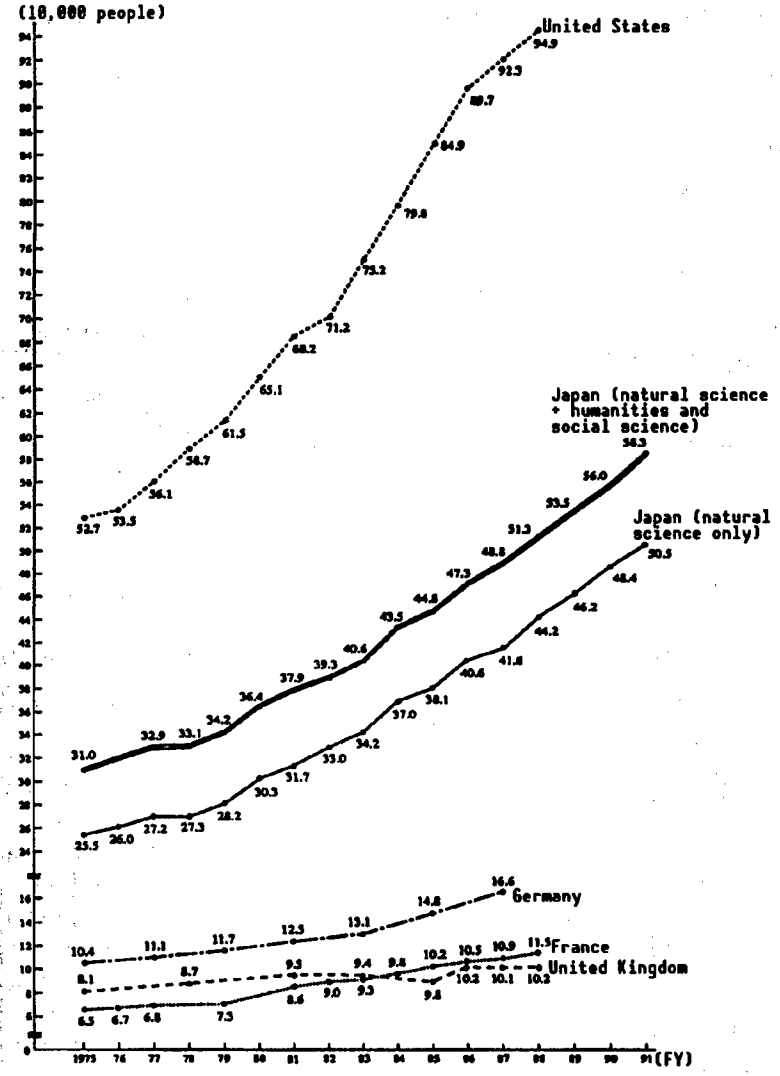
(Unit: People)

Item			(FY) 81	82	83	84	85	86	87	88	89	90	91
Natural science only	Number of research-related personnel		565,236	587,576	610,625	652,470	672,921	704,719	722,077	746,760	771,496	803,555	837,100
	Number of full-time researchers	Total number	317,487	329,728	342,237	370,045	381,282	405,554	418,337	441,876	461,634	484,346	504,966
		Firms	184,889	192,942	201,137	223,882	231,097	251,771	260,846	279,298	294,202	313,948	330,996
		Research organizations	30,006	32,674	31,170	31,980	31,167	32,459	33,257	34,469	35,710	36,265	37,084
		Universities, etc.	102,592	104,112	109,930	114,183	118,018	121,324	124,234	128,109	131,722	134,133	136,886
Including humanities social sci.	Number of research-related personnel		654,984	676,277	699,111	741,288	762,821	795,949	814,656	841,246	868,715	905,643	940,306
	Number of full-time researchers		379,405	392,625	406,042	435,340	447,719	473,296	487,779	513,267	535,008	560,276	582,815

Notes: The data for each year are as of 1 April. The term "research-related personnel" means those who are engaged in research work, i.e., researchers, research assistants, skilled laborers, and other personnel involved in research work. The term "full-time researchers" means those whose main work is research within the organization and who have completed university (excluding two-year college) course work (or those who have the equivalent specialized knowledge), have two or more years of a career in research, and carry out research that has a specific theme. [Source: Same as Chart 1-7.]

Chart 1-8 Change in Number of Full-Time Researchers in Principal Countries (Natural Science + Humanities and Social Science)

The number of full-time researchers in Japan (583,000 in 1991) is on a scale next to that of the United States and is on a level that is considerably higher than that of the European countries.

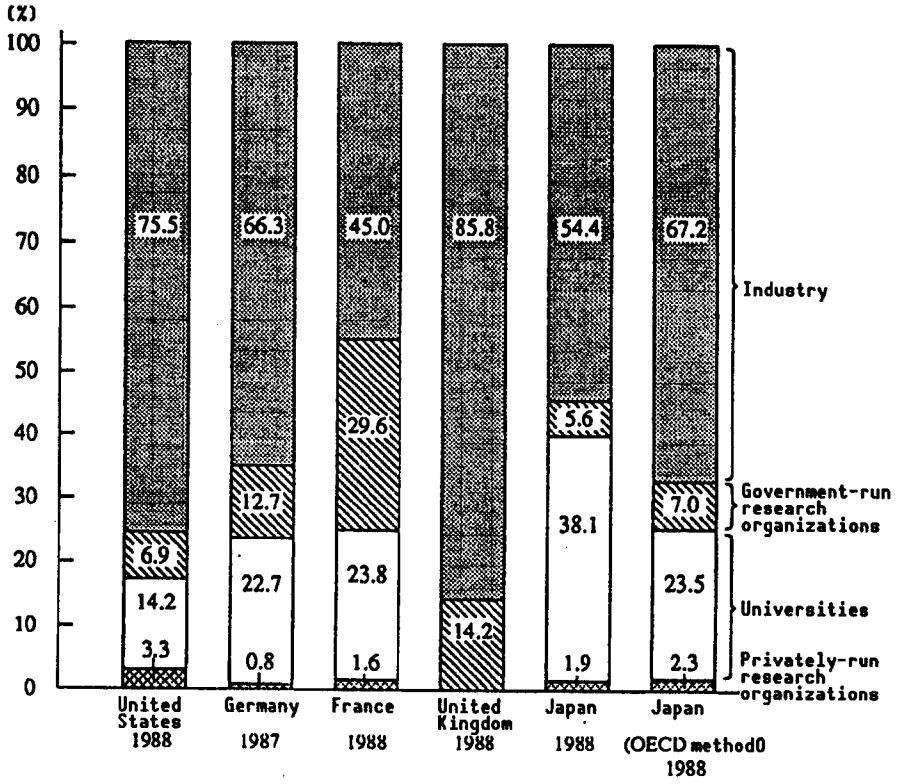


Notes: • The data for countries other than Japan are totals for natural science, humanities, and social science. • For the United Kingdom, the data are for that within industry and government. • Trial calculations of the 1991 data for Japan using the OECD full-time equivalent give values of 47.8 (natural science + humanities and social science) and 43.7 (natural science only). (For details, see Reference Data 2.)

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics* *Quoted from the
Germany: BMFT data* S&T white paper
France: Attachment to budget bill*
United Kingdom: OECD (after 1985, Annual Review of Government Funded R&D)*

Chart 1-9 Comparison of Numbers of Full-Time Researchers in Principal Countries (Natural Science + Humanities and Social Science)

A comparison of the by-organization component ratios of the numbers of full-time researchers in principal countries' shows that France has the lowest percentage of researchers in industry; in the other principal countries, industry accounts for about 60-70% of the total number of full-time researchers.



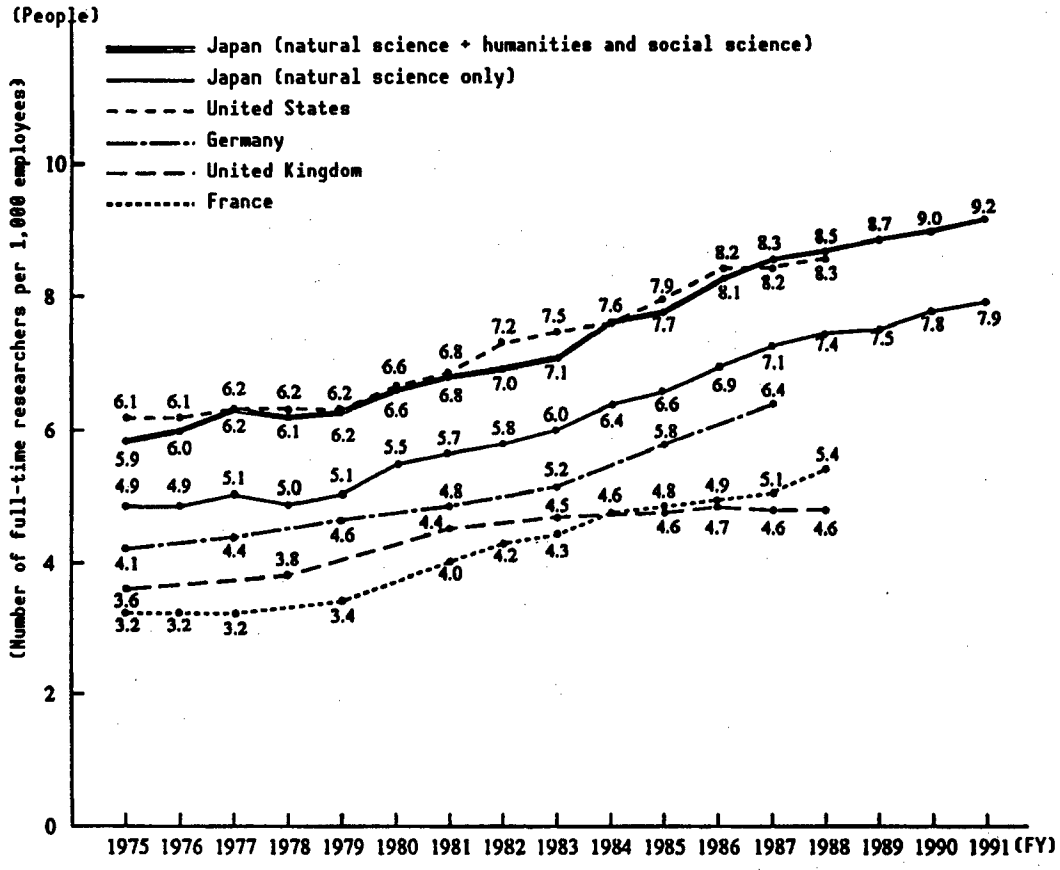
Note: For the United Kingdom, the data are for that within industry and government.

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: Annual Review of Government Funded R&D 1987, 88, British Business, 27 February 1987*

* Quoted from the S&T White Paper

Chart 1-10 Change in Number of Full-Time Researchers Per 1,000 Employees in Principal Countries (Natural Science + Humanities and Social Science)

Of the principal countries, Japan's number of full-time researchers per 1,000 employees (8.5 people, 1988) is at the highest level, followed by the United States.



Notes: • For the United Kingdom, the data are for that within industry and government.
• The data for countries other than Japan are totals for natural science, humanities and social science.
• Trial calculations of the 1991 data for Japan using the OECD full-time equivalent give values of 7.5 (natural science + humanities and social science) and 6.9 (natural science only). (For details, see Reference Data 2.)

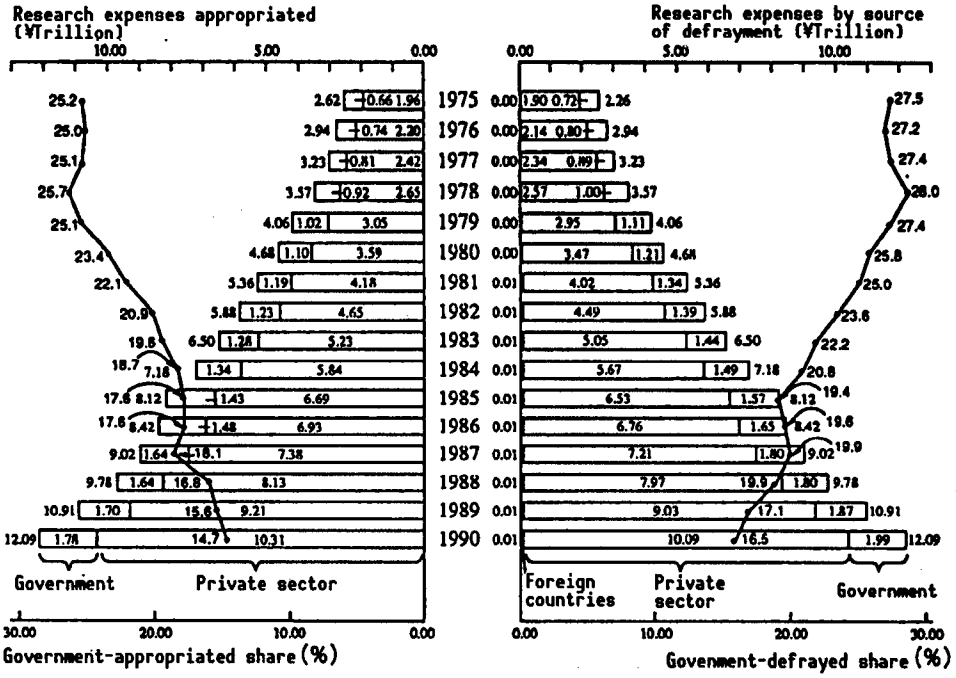
Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: OECD statistics (after 1985, Annual Review of Government Funded R&D)*

* Quoted from the S&T White Paper

2. Major R&D Bodies and the Flow of Research Expenses

Chart 2-1 Change in Research Expenses in Japan, by Government- and Private-Sector Sources of Appropriation and Defrayment (Natural Science)

The percentages of Japan's research outlays appropriated and defrayed by the government and the private-sector in FY90 were 14.7% vs. 85.3%, and 16.5% vs. 83.5%, respectively. Both peaked in FY78, and the government's share continues to decline.



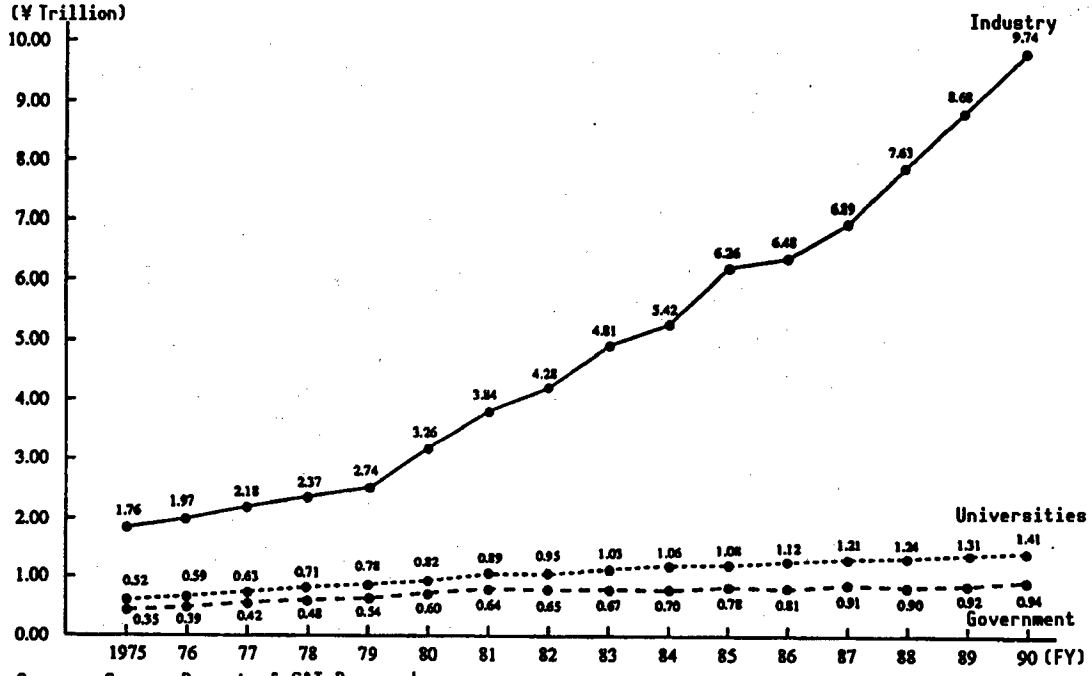
Reference Table Change in Research Expenses in Japan, by Government- and Private-Sector Sources of Appropriation and Defrayment (Natural Science)

Item / FY	Research expenses: Government (¥100 Million)	Research expenses: Government appropriated share (%)	Research expenses: Private sector (¥100 Million)	Research expenses: Private sector Component ratio (%)	Research expenses by source of defrayment: Government (¥100 Million)	Research expenses by source of defrayment: Government defrayed share (%)	Research expenses by source of defrayment: Private sector (¥100 Million)	Research expenses by source of defrayment: Private sector Component ratio (%)	Research expenses by source of defrayment: Foreign countries (¥100 Million)	Research expenses by source of defrayment: Foreign countries Component ratio (%)	Total (Appropriated research expenses = Research expenses by source of defrayment) (¥100 Million)
1975	6,620	25.2	19,558	74.8	7,206	27.5	18,993	72.4	18	0.1	26,218
76	7,365	25.0	22,049	75.0	8,004	27.2	21,384	72.7	26	0.1	29,414
77	8,110	25.1	24,225	74.9	8,861	27.4	23,437	72.5	37	0.1	32,335
78	9,188	25.7	26,511	74.3	9,995	28.0	25,674	71.9	31	0.1	35,700
79	10,186	25.1	30,450	74.9	11,138	27.4	29,464	72.5	34	0.1	40,636
80	10,982	23.4	35,856	76.6	12,096	25.8	34,696	74.1	47	0.1	46,838
81	11,860	22.1	41,780	77.9	13,403	25.0	40,178	74.9	59	0.1	53,640
82	12,271	20.9	46,544	79.1	13,888	23.6	44,860	76.3	67	0.1	58,815
83	12,779	19.6	52,258	80.4	14,407	22.2	50,549	77.7	81	0.1	65,037
84	13,388	18.7	58,378	81.3	14,945	20.8	56,748	79.1	72	0.1	71,765
85	14,301	17.6	66,863	82.4	15,740	19.4	65,346	80.5	78	0.1	81,164
86	14,809	17.6	69,341	82.4	16,517	19.6	67,557	80.3	76	0.1	84,150
87	16,359	18.1	73,803	81.9	17,983	19.9	72,101	80.0	78	0.1	90,162
88	16,421	16.8	81,331	83.2	18,014	18.4	79,655	81.5	82	0.1	97,752
89	17,018	15.6	92,075	84.4	18,679	17.1	90,318	82.8	96	0.1	109,093
90	17,805	14.7	103,091	85.3	19,901	16.5	100,893	83.5	101	0.1	120,896

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 2-2 Change in Research Expenses Appropriated by Industry, Government, and Universities in Japan (Natural Science)

Industry appropriated 80.6% of the research expenses in Japan in FY90; universities, 11.6%; and the government, 7.8%. Since 1980 the increase in industry's percentage of Japan's research expenses has been remarkable.



Source: Survey Report of S&T Research (Management and Coordination Agency)

Reference Table Change in Research Expenses Appropriated by Industry, Government, and Universities in Japan (Natural Science)

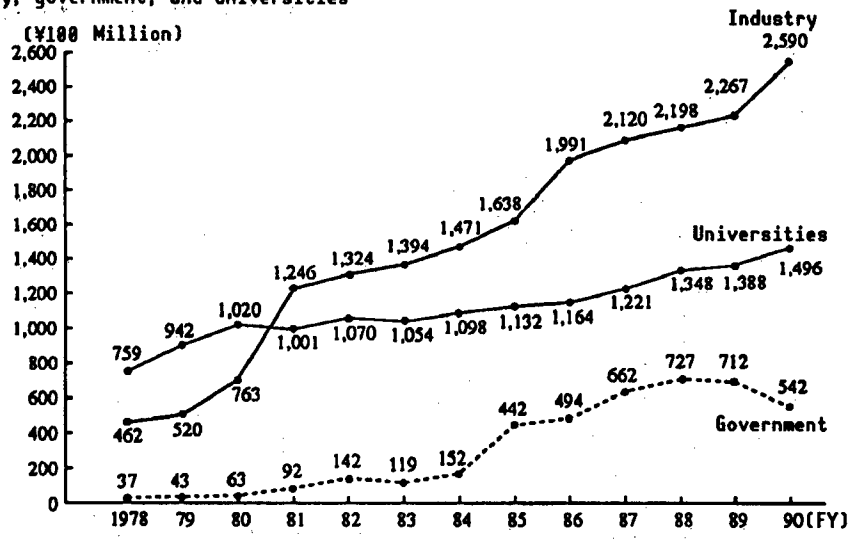
Category / FY	Industry		Universities		Government		Total
	Research expenses (¥100 Mil.)	Component ratio (%)	Research expenses (¥100 Mil.)	Component ratio (%)	Research expenses (¥100 Mil.)	Component ratio (%)	Research expenses (¥100 Mil.)
1975	17,574	67.0	5,163	19.7	3,481	13.3	26,218
76	19,671	66.9	5,877	20.0	3,866	13.1	29,414
77	21,805	67.4	6,297	19.5	4,233	13.1	32,335
78	23,734	66.5	7,126	20.0	4,839	13.5	35,700
79	27,410	67.5	7,777	19.1	5,449	13.4	40,636
80	32,648	69.7	8,239	17.6	5,951	12.7	46,838
81	38,432	71.7	8,854	16.5	6,354	11.8	53,640
82	42,832	72.8	9,482	16.1	6,501	11.1	58,815
83	48,082	73.9	10,284	15.8	6,672	10.3	65,037
84	54,166	75.4	10,638	14.8	7,011	9.8	71,765
85	62,564	77.1	10,754	13.2	7,846	9.7	81,164
86	64,806	77.0	11,219	13.3	8,125	9.7	84,150
87	68,926	76.4	12,096	13.4	9,140	10.1	90,162
88	76,308	78.1	12,396	12.7	9,048	9.2	97,752
89	86,756	79.5	13,116	12.0	9,221	8.5	109,093
90	97,426	80.6	14,063	11.6	9,407	7.8	120,896

Source: Survey Report of S&T Research (Management and Coordination Agency)

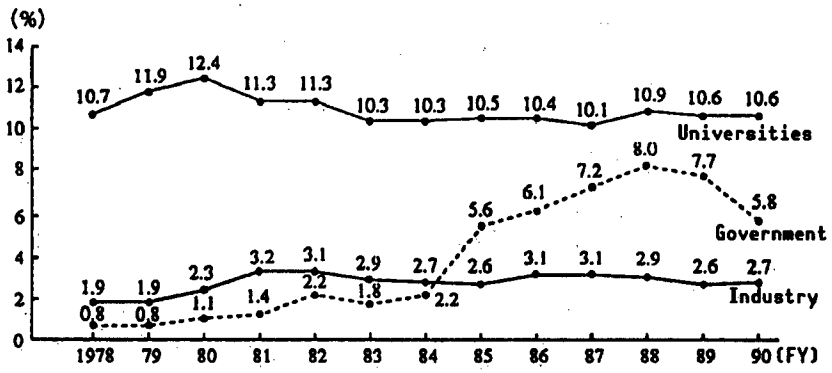
Chart 2-3 Change in Amount of Research Expenses Received by Japanese Industry, Government, and Universities from Other Departments (Natural Science)

The amounts of research expenses that industry, government, and universities receive from other departments [e.g., that which industry receives from the government or from foreign countries] has been increasing over the years. In particular, the growth in the amount that industry receives from other departments has been remarkable, but because there has been a steady growth in industry's total research expenses, the share of industry's research expenses that are received from other departments has shifted about 3%. Although the percentage of research expenses that universities receive from other departments is relatively high, at about 10%, the share of that coming from industry has been increasing and accounts for more than 30% of the total research expenses received by universities.

(1) Research expenses received* from other departments by industry, government, and universities

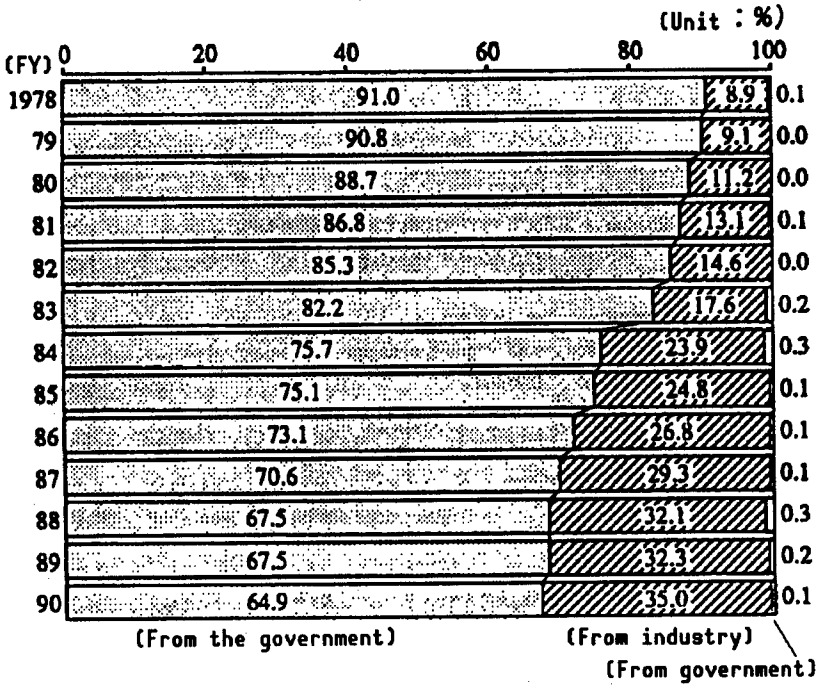


(2) Percentages of research expenses received from other departments by industry, government, and universities (share of total research expenses for which research expenses received* account)



[Chart continued]

(3) Breakdown of research expenses received* by universities



Note: * The term "research expenses received" means the research expenses that each research organization received from the outside and used internally.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Table 2-4 Share of Research Expenses Defrayed by Government in Principal Countries (Natural Science + Humanities and Social Science)

The share of Japan's nondefense research expenses defrayed by the government (17.3% in FY90) is the lowest level of that in principal countries.

Category / Country (FY)	Research expenses (¥100 million)	Defense research expenses (¥100 million)	Defrayed by government (¥100 million)	Percentage defrayed by government	Excluding defense research expenses
Japan (1988)	106,276	827	21,178	19.9	19.3
(OECD conversion)	(99,016)		(17,648)	(17.8)	(17.1)
Japan (1989)	118,155	931	22,024	18.6	18.0
(OECD conversion)	(110,464)		(18,289)	(16.6)	(15.8)
Japan (1990)	130,783	1,043	23,466	17.9	17.3
(OECD conversion)	(122,466)		(19,467)	(15.9)	(15.2)
United States (88)	171,457	48,757	79,658	46.5	25.2
United States (89)	193,872	55,705	90,873	46.9	25.5
United States (90)	210,612*	59,481	100,202*	47.6	26.9
Germany (1988)	46,486	2,259	16,406	35.3	32.0
Germany (1989)	47,565	2,252	15,813	33.2	29.9
France (1988)	28,099	6,971	14,283	50.8	34.6
France (1989)	30,679*	7,130	15,112*	49.3	33.9
United Kingdom(88)	22,411	4,776	8,666	38.7	22.1
United Kingdom(89)	23,953	4,546	8,654	36.7	21.6

Notes: •Percentage defrayed by the government, excluding defense research expenses (%) = (research expenses defrayed by the government − defense research expenses)/(research expenses − defenses research expenses) x 100.

• The data are totals for natural science, humanities and social science. However, U.K. data are only for natural science.

• The asterisks indicate provisional values.

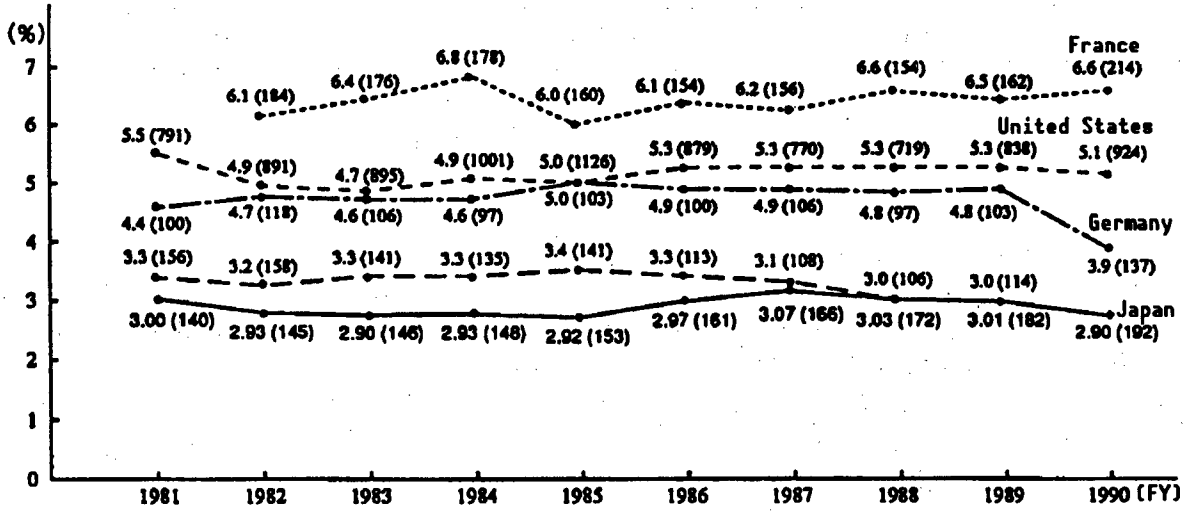
• The data within parentheses are calculated using the OECD full-time equivalent method. (For details, see Reference Data 2.)

Sources: Japan: Survey Report of S&T Research (Management & Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: Attachment to budget bill*
United Kingdom: OECD statistics (after 1981, Annual Review of Government Funded R&D)*

* Quoted from the S&T White Paper

Chart 2-5 S&T Budget Share of National Budget in Principal Countries

In the principal countries S&T budgets generally shift between 3~7% of the total national budgets, but Japan's S&T budget is shifting to the lowest level among the major advanced countries.

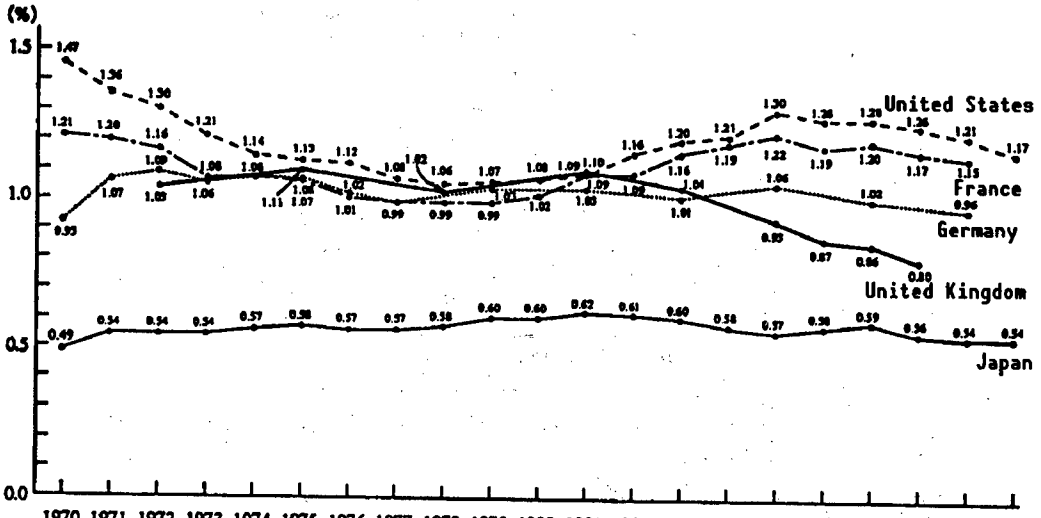


Notes:
1. The accounting demarcations of each countries' total budgets and S&T budgets differ.
2. A general account is appropriated in Japan's total budget.
3. Germany's budget is only that of the federal government, and most of the research expenses in universities, which are almost totally born by the states, are not included.
4. The figures in parentheses show the S&T budget amounts (in units of ¥100 million).

Sources: Japan: Budget text*
United States: Budget message*
Germany: Faktenbericht 1990 zum Bundesbericht Forschung 1988
Finanzbericht*
France: Attachment to budget bill*
United Kingdom: Annual Review of Government Funded R&D 1989, 1990
The Government Expenditure Plans to 1990-91, 1991-92*
* Quoted from the S&T White Paper

Chart 2-6 Principal Countries' Government Research Expenditures as a Percentage of GNP (Natural Science + Humanities and Social Science)

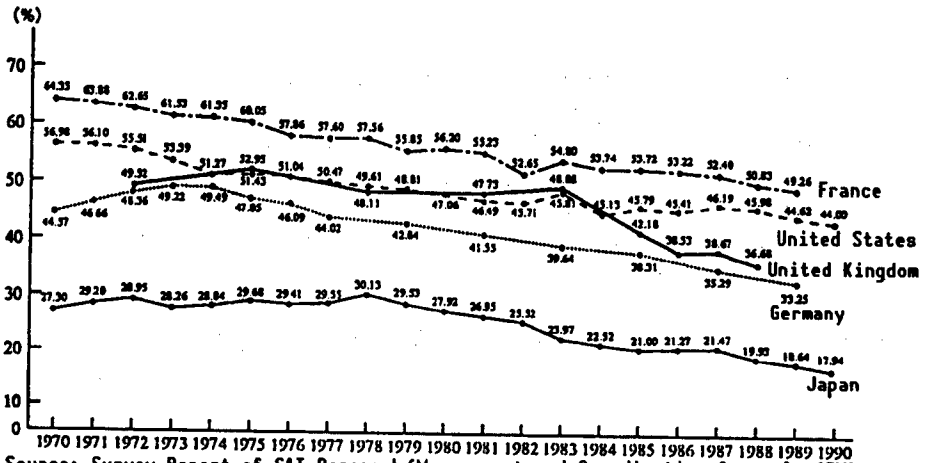
Government research expenditures as a percentage of GNP have been about 1% for other principal countries, but that for Japan has been at a very low level of about 0.5%.



Source: Survey Report of S&T Research (Management and Coordination Agency)
S&T White Paper (Science and Technology Agency)

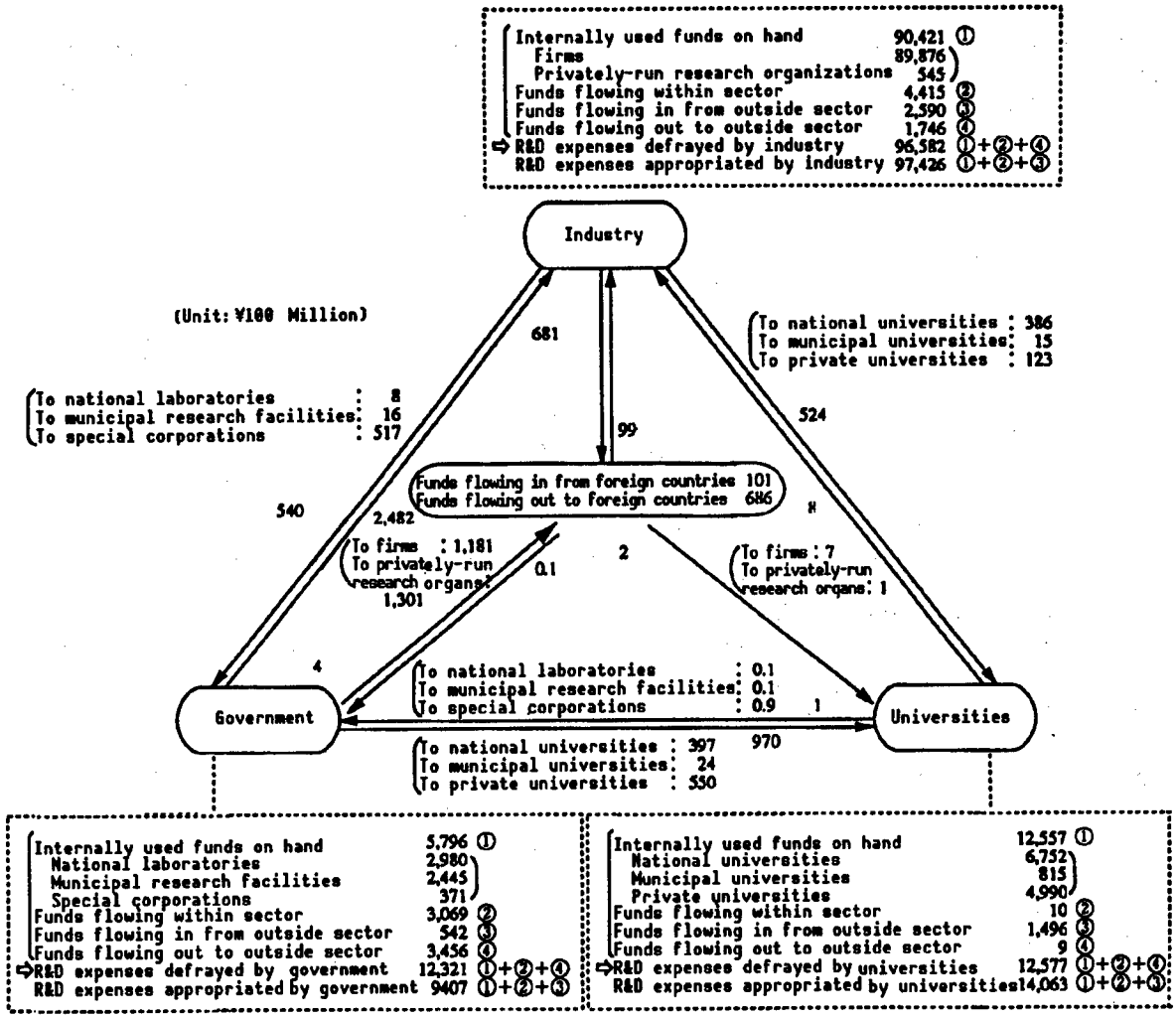
Chart 2-7 Principal Countries' Government Research Expenditures as a Percentage of Total Research Expenditures (Natural Science + Humanities and Social Science)

The principal countries' government research expenditures as percentages of total research expenditures have shifted between 30~60%. However, that for Japan in FY90 was 18%, which is the lowest level of the principal advanced countries.



Source: Survey Report of S&T Research (Management and Coordination Agency)
S&T White Paper (Science and Technology Agency)

Chart 2-8 Flow of Japan's R&D Capital (Natural Science Only) (Breakdown of Research Expenses Received by Industry, Government, and Universities) (FY90)



Notes:
- The data are totals based on the research expenses received by each research organization. The term "research expenses received" means the research expenses that each research organization received from the outside and used internally.
- The data on the funds going to foreign countries are the total amounts of money disbursed to foreign countries as research expense items.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 2-9 Shares of Appropriated Research Expenses in Principal Countries, by Organization (Natural Science + Humanities and Social Science)

Looking at the percentages for organizations of the research spending of principal countries, we see that the corporate share is highest in each country—approximately 60–70%. Also, Japan's figure for government's share is lowest among the principal countries.

(Unit: %)

Country (FY)	Firms	Government	Privately-run research organizations	Universities, etc.
Japan (1988)	67.9	8.8	4.3	19.0
(OECD conversion)	(72.9)	(9.4)	(4.6)	(13.0)
Japan (1989)	69.7	8.1	4.2	18.0
(OECD conversion)	(74.5)	(8.6)	(4.5)	(12.3)
Japan (1990)	70.9	7.5	4.1	17.6
(OECD conversion)	(75.7)	(8.0)	(4.4)	(12.0)
United States (1988)	73.2	10.7	2.7	13.5
United States (1989)	72.3	10.8	2.9	14.0
United States (1990)	71.6*	11.1*	3.0*	14.3*
Germany (1988)	72.4	12.7	0.5	14.4
Germany (1989)	73.0	12.3	0.6	14.1
Germany (1990)	73.5	12.0	0.5	13.9
France (1988)	58.9	25.2	0.9	15.0
France (1989)	59.5	24.9	0.9	14.8
United Kingdom (1988)	67.0	15.1	3.7	14.2
United Kingdom (1989)	66.4	14.3	4.0	15.3

Notes:
- The data are totals for natural science, humanities and social science. However, the United Kingdom data are only for natural science.
- The asterisks indicate provisional values.
- The data within parentheses are calculated using the OECD full-time equivalent method. (For details, see Reference Data 2.)

Sources: Japan: Survey Report of S&T Research (Management and Coordination Agency)
United States: NSF statistics*
Germany: OECD statistics*
France: OECD statistics*
United Kingdom: Annual Review of Government Funded R&D*
* Quoted from the S&T White Paper

Chart 2-10 Share of Government Funding for Research in Industry in Principal Countries (Natural Science + Humanities and Social Science)

In Europe and the United States, government provides 20–30% of industry's research funds. By comparison, Japan's proportion is approximately 3%.

Country / FY	Japan (1990)	United States (1990	Germany (1989)	France (1987)	United Kingdom (1988)
Ratio (%)	2.7	31.2*	20.7	22.8	18.1

Notes:
- Asterisk indicates a provisional value.
- Privately-run research organizations are included under the category of industry. For example, in the case of Japan the calculation is based on the following formula:

$$\frac{\text{Government funding in firms' research expenses + government funding in privately-run research organizations' research expenses}}{\text{Total amount of firms' research expenses + total amount of privately-run research organizations' research expenses)}} = \frac{1,188 + 1,443}{92,672 + 5,373} \fallingdotseq 0.027$$

- The data are totals for natural science, humanities and social science. However, the United Kingdom data are only for natural science.

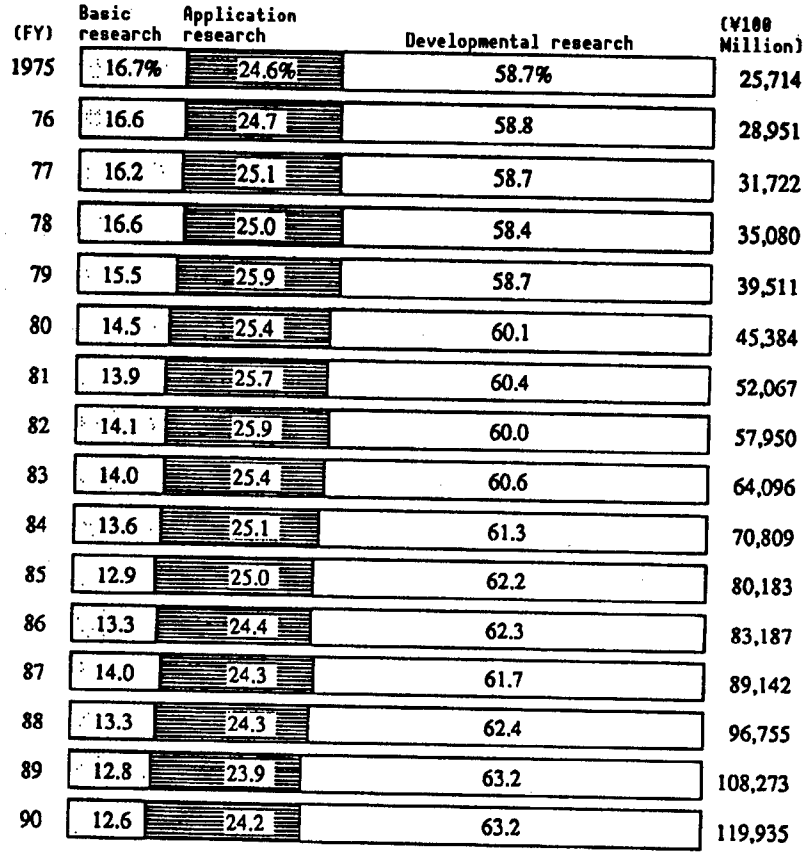
Sources:
Japan: Survey Report of S&T Research (Management and Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*
France: OECD statistics*
United Kingdom: Annual Review of Government Funded R&D*

* Quoted from the S&T White Paper

3. Nature of the Research

Chart 3-1 Change in Breakdown of Japan's Research Expenses, by Nature of the Research (Natural Science)

A look at Japan's natural science research expenses according to the nature of the research shows that the percentage of expenses for basic research is still as low as ever (about 13%).



Notes: • Basic research—Theoretical or practical research that does not directly take special applications into consideration and is either conducted for the purpose of formulating hypotheses or theories, or for gaining new knowledge about phenomena or observable facts.

Application research—Research that uses knowledge discovered through basic research, sets up specific objectives, and then verifies the possibility of practical application of that knowledge, or, in connection with methods that have already been put into practical use, research that involves searching for new applications.

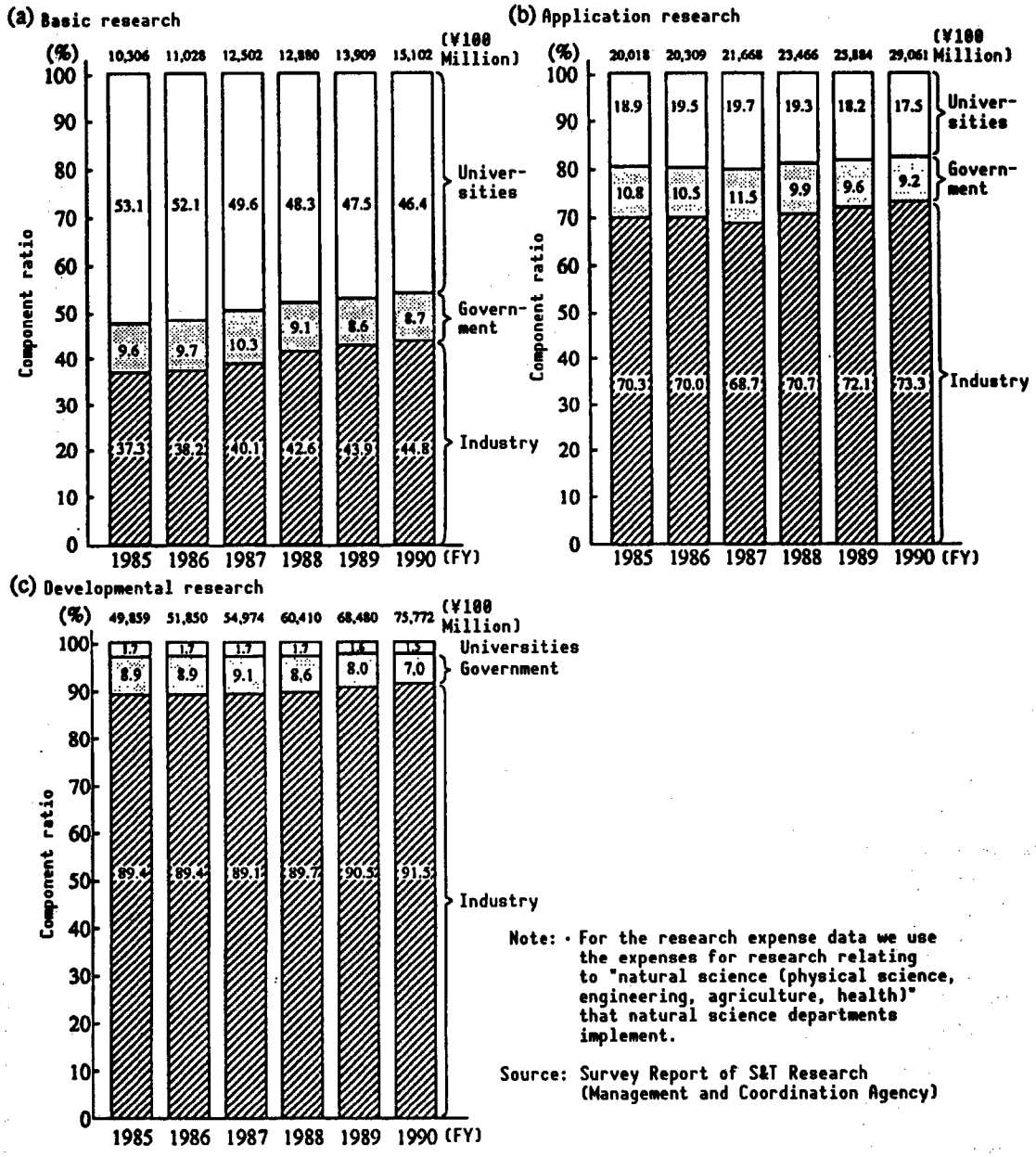
Developmental research—The utilization of knowledge gained from basic research, application research, or actual experiments; research aimed at introducing new materials, devices, products, systems, processes, etc., or research aimed at improving existing new materials, devices, products, systems, processes, etc.

• For the research expense data we use the expenses for research relating to "natural science (physical science, engineering, agriculture, health)" that natural science departments implement.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 3-2 Change in Breakdown of Japan's Research Expenses, by Nature of the Research and by Organization (Natural Science)

A breakdown of Japan's natural science research by nature of the research and by organization shows a basic configuration where firms are heavy in application and developmental research, and universities are heavy in basic research.



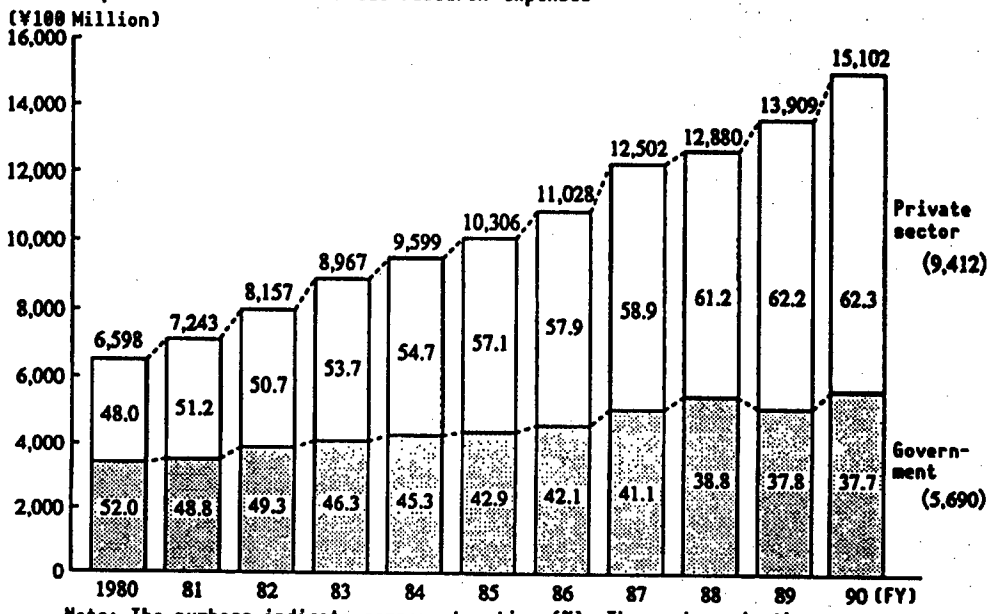
Note: · For the research expense data we use the expenses for research relating to "natural science (physical science, engineering, agriculture, health)" that natural science departments implement.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 3-3 Change in Government-Private Breakdown of Japan's Basic Research Expenses (Natural Science)

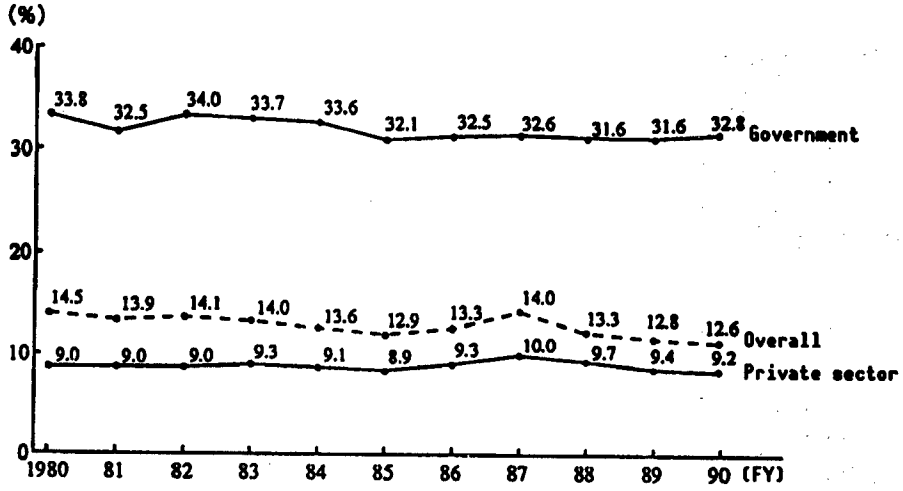
A breakdown of Japan's government and private-sector basic research expenses shows that since FY81 the private-sector share grew successively larger than that of the government, and in FY91 it was 62%, versus 38% for the government. In addition, the government spent about 30% of its total research expenses on basic research; the private sector spent about 10%.

(1) Government-private breakdown of basic research expenses



Note: The numbers indicate component ratios (%). The numbers in the upper part of the chart indicate total amounts.

(2) Government and private-sector basic research ratios*



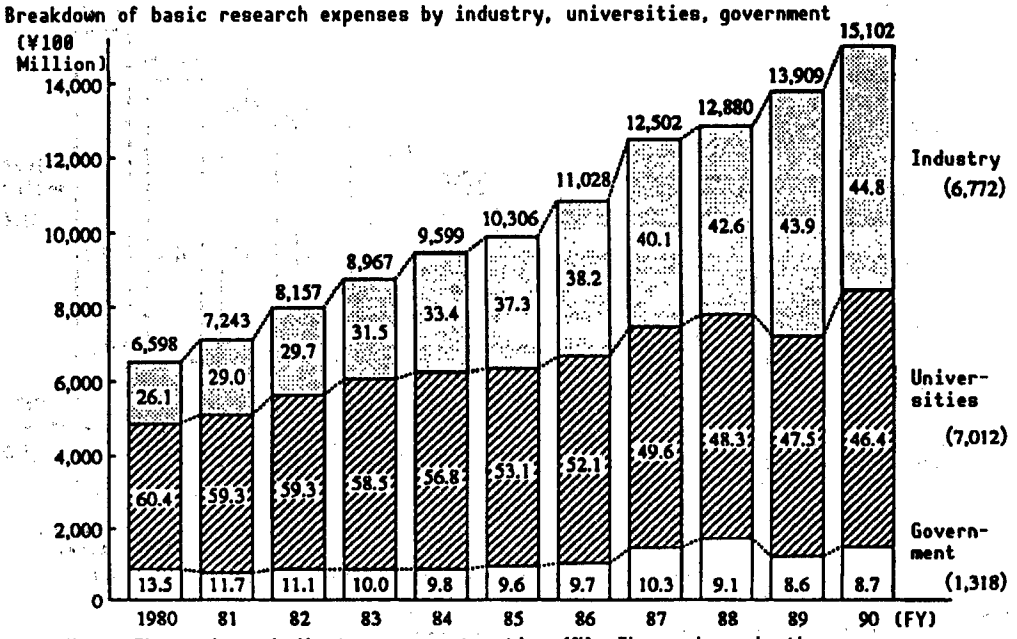
* Basic research ratio means the percentage of total research expenses that went for basic research expenses.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 3-4 Change in Government-Industry-University Breakdown of Japan's Basic Research Expenses (Natural Science)

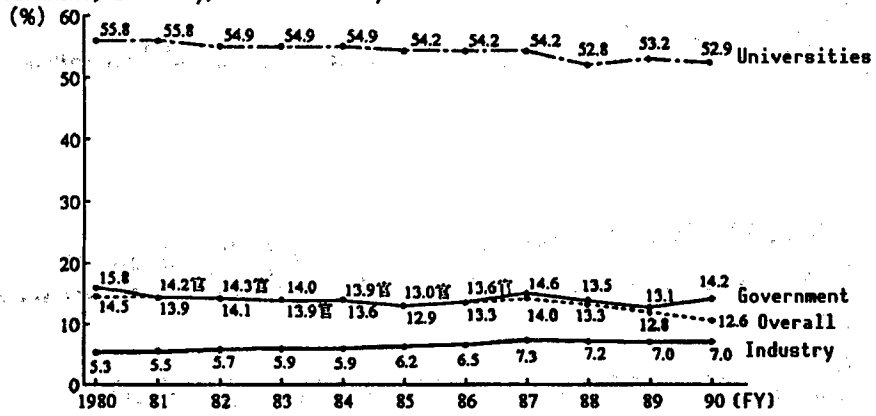
A breakdown of Japan's government, industry, and university basic research expenses shows that, although universities accounted for more than 60% of Japan's basic research expenses in the past, industry's basic research expenses have also been increasing over the years, and in FY90 industry's share of basic research expenses reached its highest point, 44.8%. In addition, universities spent about 53% of their total research expenses on basic research; the government, 14%; and industry, 7% (FY90).

(1) Breakdown of basic research expenses by industry, universities, government



Note: The numbers indicate component ratios (%). The numbers in the upper part of the chart indicate total amounts.

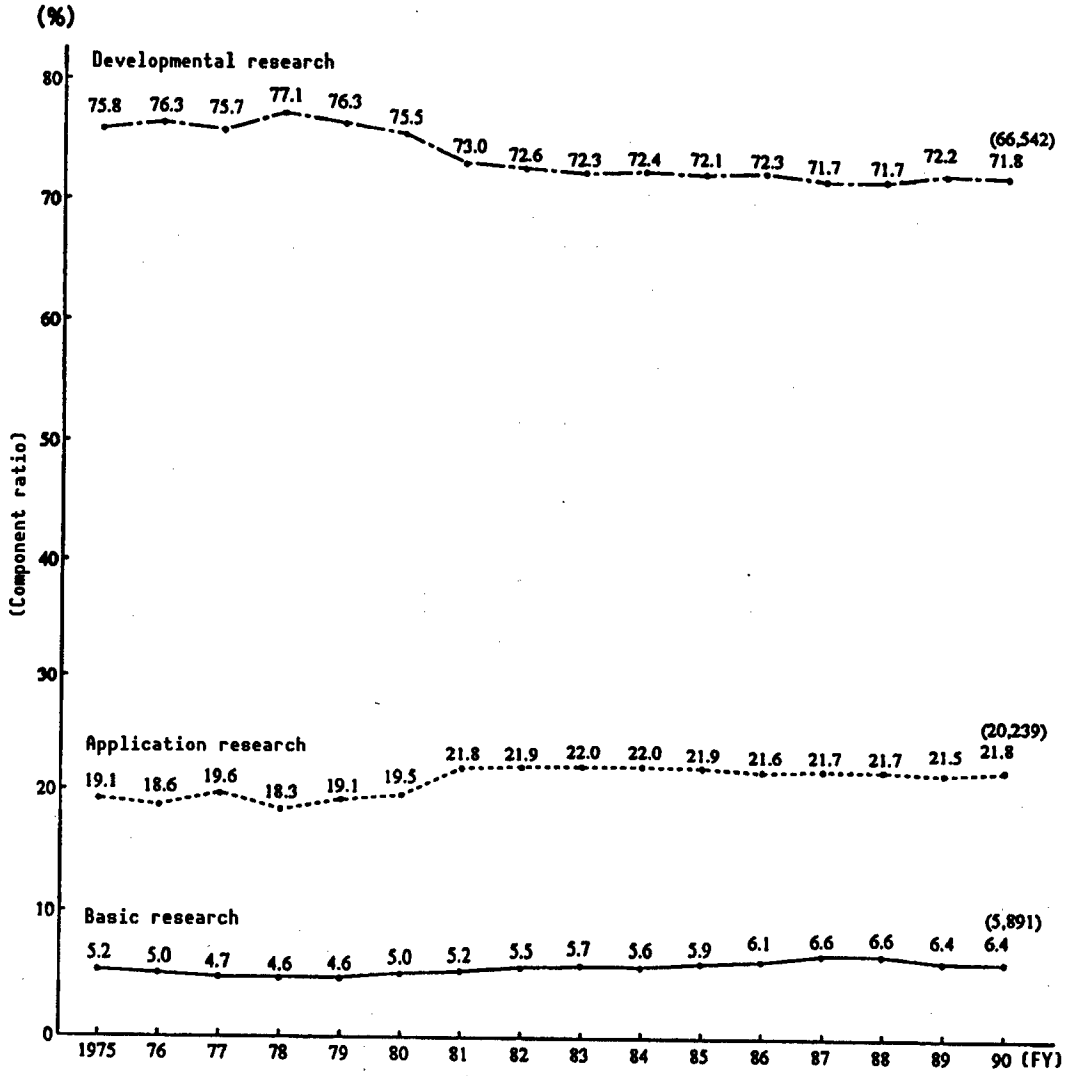
(2) Government, industry, and university basic research ratios



Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 3-5 Change in Breakdown of Japanese Firms' Research Expenses, by Nature of the Research

A breakdown of Japanese firms' research expenses by nature of the research shows that developmental research accounted for about 70% and application research accounted for about 20% of the total research expenses. The percentage of firms' research expenses that went for basic research is still at a low level, about 6%.

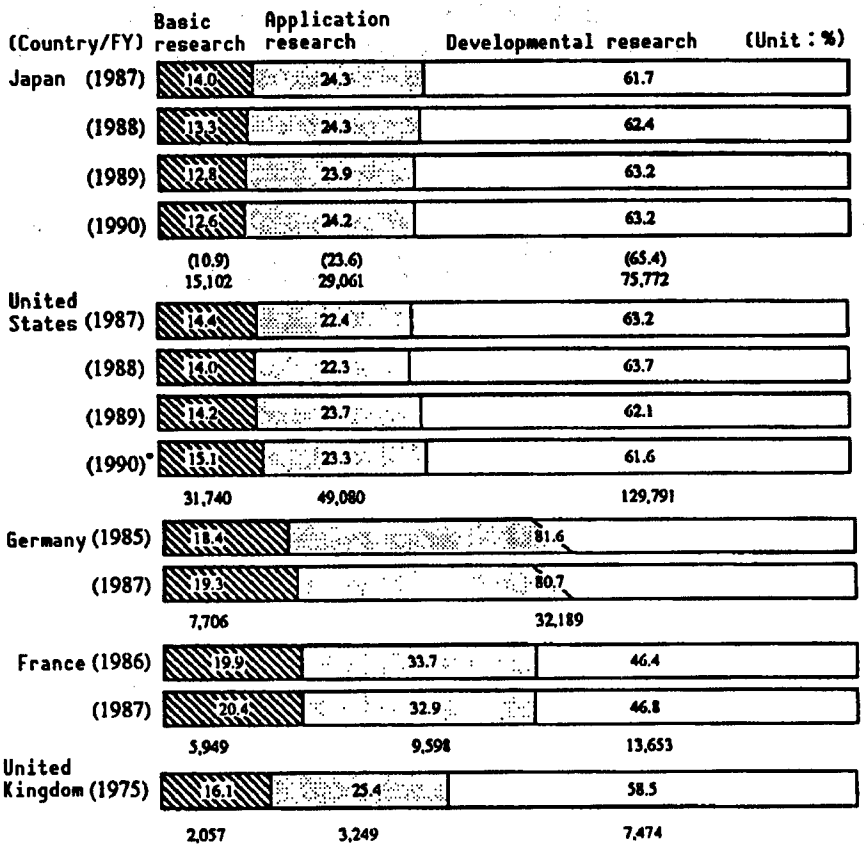


Note: The figures in parentheses indicate research expenses in units of ¥100 million)

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 3-6 Breakdown of Principal Countries' Research Expenses, by Nature of the Research (Natural Science)

Japan's basic research ratio is the lowest level among the principal countries.



Notes: • The data for Japan, Germany, and the United Kingdom are for only for natural science. That for France and the United States includes humanities and social science.

• The small blank circles indicate provisional values.

• The data within parentheses are calculated using the OECD full-time equivalent method. (For details, see Reference Data 2.) Incidentally, here we do a trial calculation with the assumption that universities' funds on hand account for 90% of the research expenses appropriated by universities in basic, application, and developmental research.

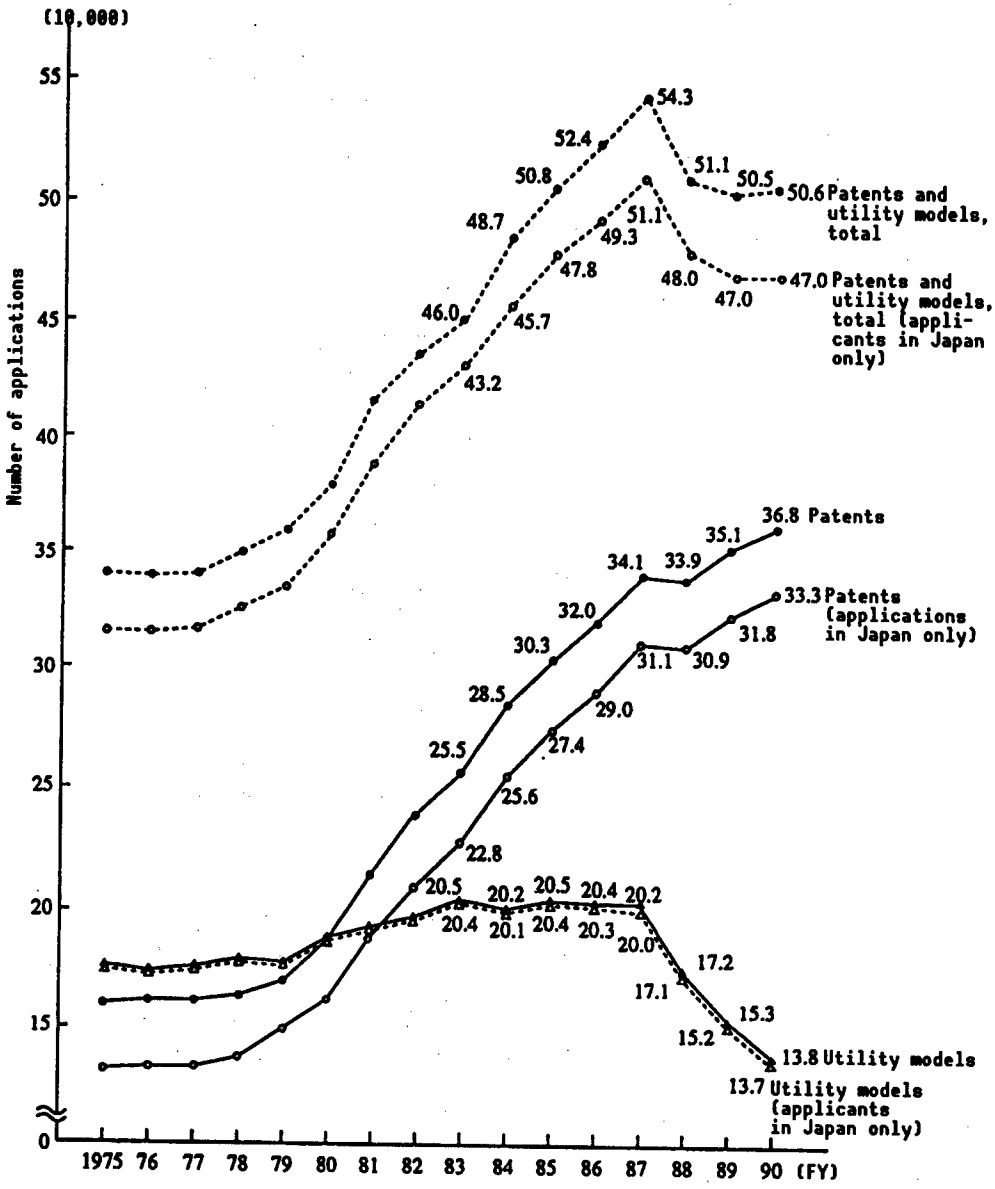
• The figures at the bottoms of the graphs are amounts of money (in units of ¥100 million) for the corresponding field.

Sources: Japan: Survey Report of S&T Research (Management and Coordination Agency)
United States: NSF statistics
Germany: OECD statistics
France: OECD statistics
United Kingdom: OECD statistics

4. Patent Trends

Chart 4-1 Change in Numbers of Patent and Utility Model Applications in Japan

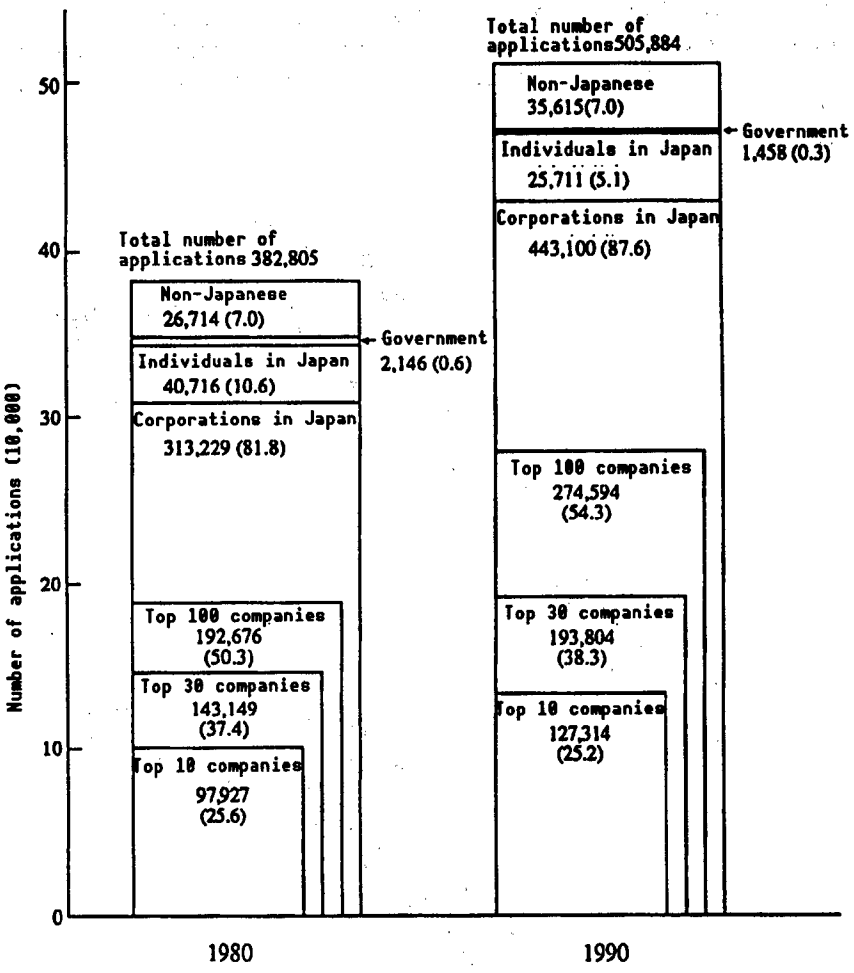
The declining trend since 1988 in the number of patent and utility model applications in Japan eased in 1990, when the total number of applications was 506,000. A breakdown shows that the number of utility model applications decreased 9.8% over the previous year. A factor in that is thought to be the effect of application rationalization policies that the Patent Office started implementing in 1985.



Source: Annual Report of the Patent Office (Patent Office)

Chart 4-2 Numbers of Patent and Utility Model Applications in Japan, by Type of Applicant

Corporations in Japan acccount for the overwhelmingly largest share, on the order of 90%, of the total number of patent and utility model applications held in Japan in 1990. Furthermore, of those corporations in Japan, the top 100 companies account for more than 50% of the number of applications.

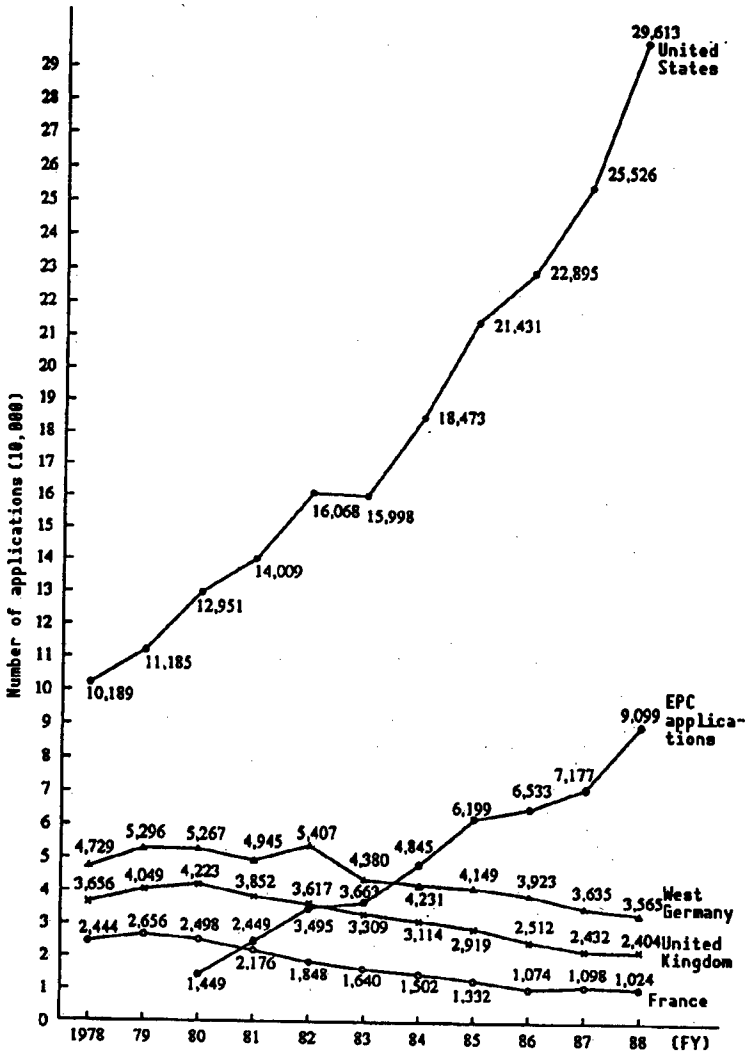


Note: The figures in parentheses indicate the percentage of applications held with respect to the total number of applications.

Source: Annual Report of the Patent Office (Patent Office)

Chart 4-3 Change in Number of Japanese Patent Applications in Principal Countries

The number of patent applications that Japan makes overseas has been rapidly increasing: in 1978 about 10,000 applications were made in the United States, and in 1988 that number reached almost 30,000. Patent applications in European countries have tended to decline, but that is because reception of European patent applications (EPC applications) started in 1978; overall, Japan's patent applications in Europe are tending to increase.

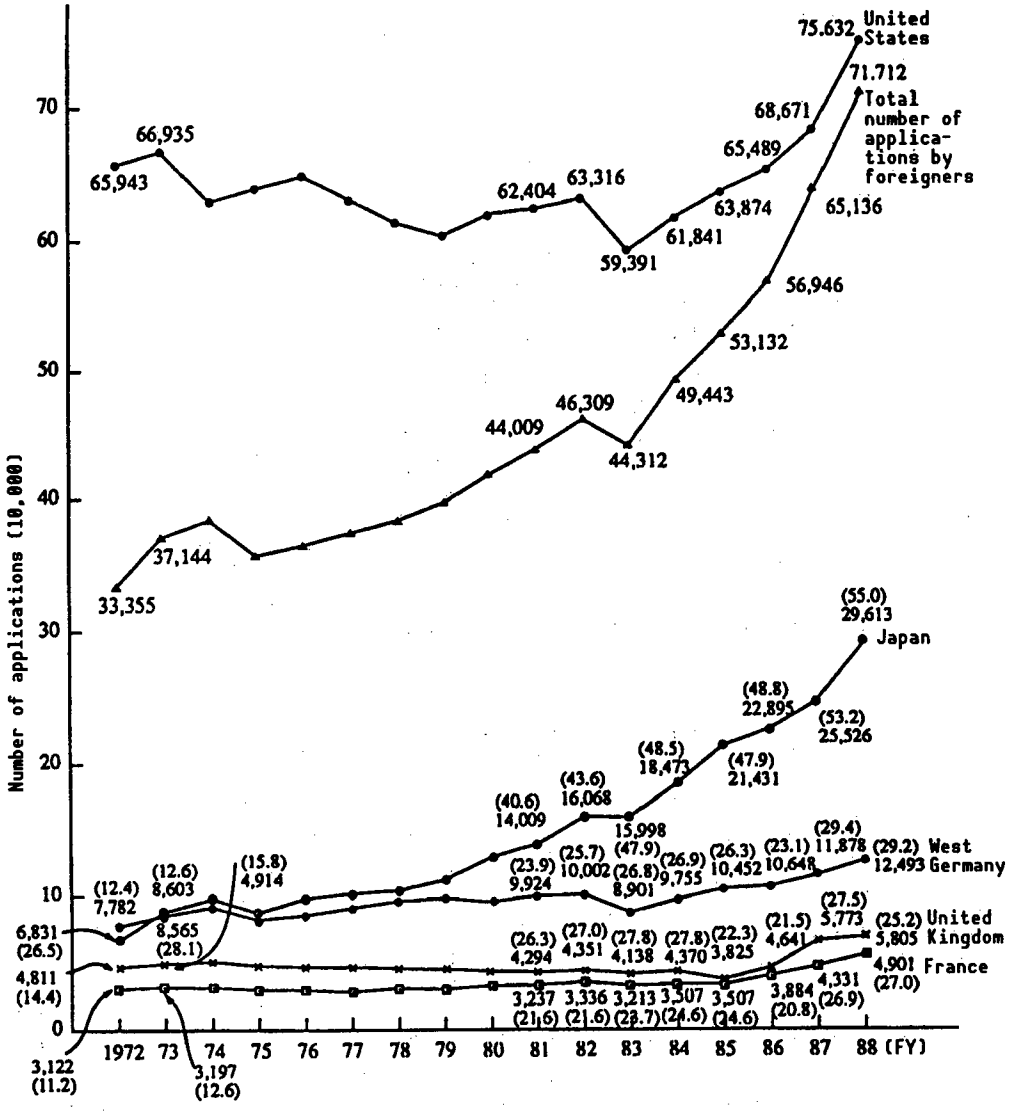


Note: EPC applications: In Europe the European Patent Convention (EPC) came into effect in 1977, and since 1978 patent applications are received by the European Patent Office (EPO). An EPC application is reviewed by the EPO, and European patent rights are granted. As for the range of areas over which European patent rights extend, there is a "designated country system," and the patent applicant can specify which of the EPC signatory countries (more than one country is possible) in which he wants to acquire patent rights. There are now 13 EPC signatory countries that include West Germany, the United Kingdom, and France.

Sources: Annual Report of the Patent Office (Patent Office)
Annual Report of the EPO (EPO)

Chart 4-4 Change in Number of Each Country's Patent Applications in the U.S.

A look at the change in the number of patents applied for in the United States shows that since 1983 the number of patent applications from within the United States shifted from a trend of no marked fluctuations to an increasing trend, and patent applications from other countries also increased rapidly. U.S. patent applications from West Germany, the United Kingdom, and France show no marked fluctuations, whereas applications from Japan are tending to increase. Of the applications for U.S. patents by foreigners in 1988, 41% of the total number were from Japan. In addition, the percentage of the total number of Japan's foreign patent applications for which U.S. patent applications account (55%) is conspicuously high.



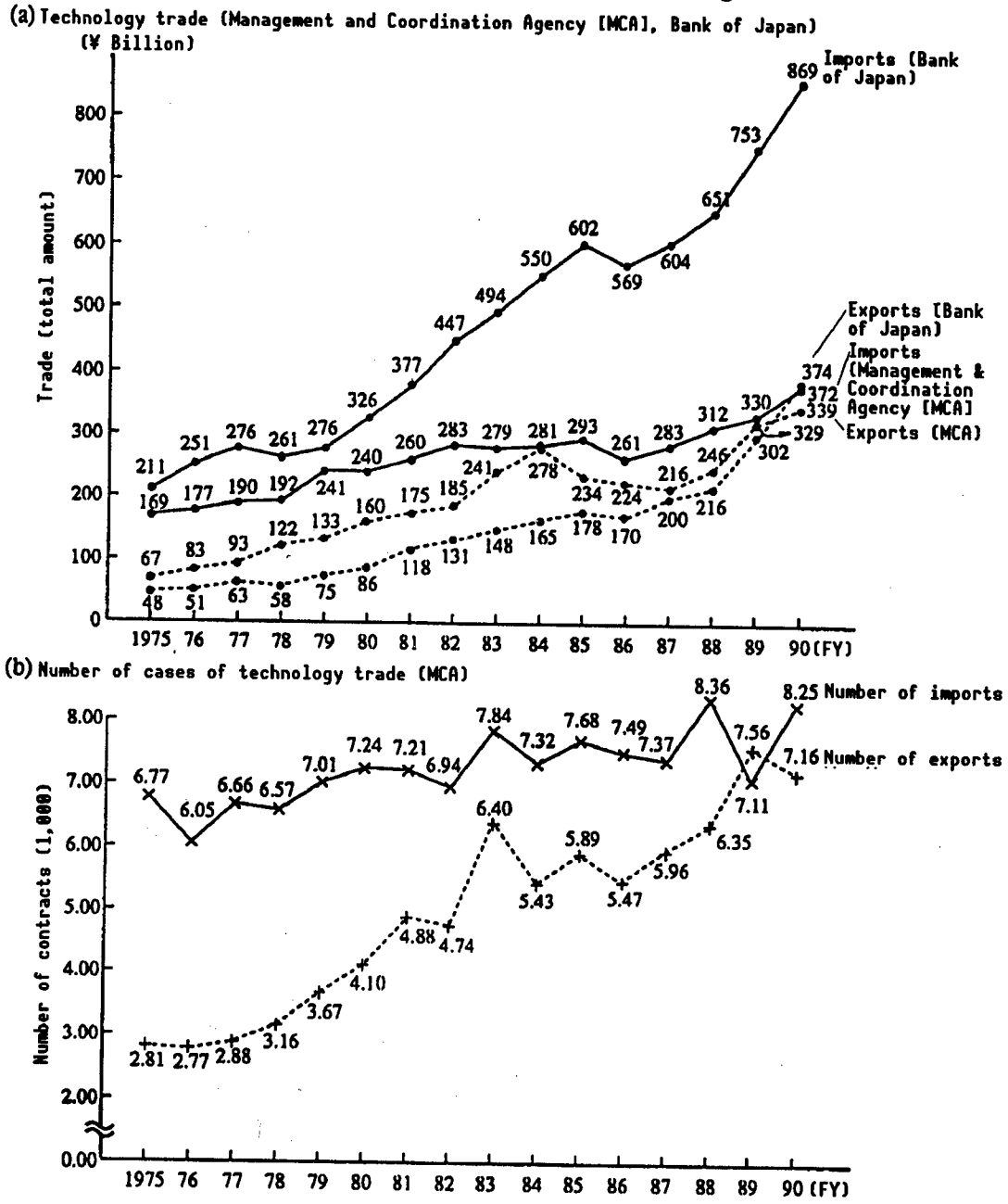
Note: The figures in parentheses indicate the percentage of the total number of the country's foreign patent applications for which U.S. patent applications account.

Source: Annual Report of the Patent Office (Patent Office)

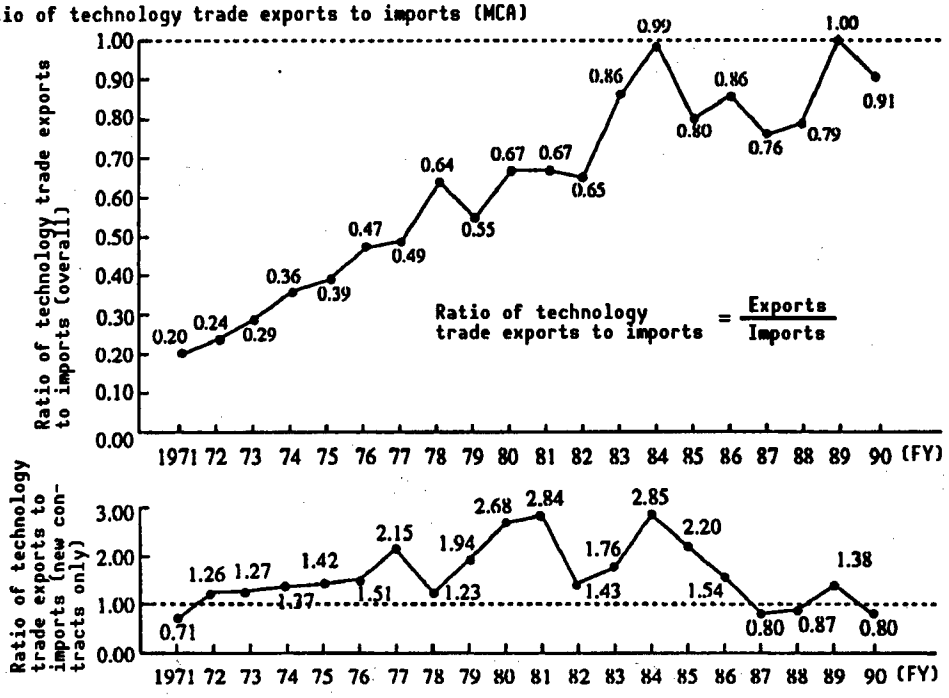
5. Trends in Technology Trade

Chart 5-1 Change in Japan's Technology Trade

Technology trade in FY90 showed the highest amounts of both imports and exports. Although the ratio of technology exports to imports in FY89 was 1.0, which was the highest it had ever been, it dropped again in FY90 to 0.91.



(c) Ratio of technology trade exports to imports (MCA)



Classification			(FY) 1984	85	86	87	88	89	90
Survey of S&T Research (MCA)	Amount of trade (¥100 Million)	Exports Total	2,775	2,342	2,241	2,156	2,463	3,293	3,394
		Exports New	909	733	518	448	474	666	586
		Imports Total	2,814	2,932	2,606	2,832	3,122	3,299	3,719
		Imports New	318	333	336	562	546	484	734
	Number of cases	Exports Total	5,426	5,885	5,469	5,955	6,352	7,559	7,163
		Exports New	1,824	2,099	1,730	1,655	1,850	2,084	1,570
		Imports Total	7,316	7,679	7,494	7,373	8,356	7,109	8,249
		Imports New	982	1,245	1,141	813	1,382	1,056	956
	Exports/imports	Total	0.99	0.80	0.86	0.76	0.79	1.00	0.91
		New	2.85	2.20	1.54	0.80	0.87	1.38	0.80
Balance of international payments statistics (Bank of Japan)	Number of trading firms	Exports	1,345	1,637	1,278	1,448	1,716	2,294	1,879
		Imports	1,753	1,669	1,467	1,471	1,851	1,500	1,805
	Amount of trade (¥100 Million)	Exports	1,646	1,779	1,700	2,003	2,155	3,021	3,739
		Imports	5,503	6,015	5,687	6,040	6,507	7,528	8,694
	Exports/imports		0.30	0.30	0.30	0.33	0.33	0.40	0.43

Notes: • The Management and Coordination Agency's technology trade indicates the "technology trade" reported in the Survey Report of S&T Research.
• The Bank of Japan's technology trade indicates the "royalties" reported in the Monthly Report of International Payments Statistics.
• As for the differences between the two sets of data, see Reference Data 3 (Relative Comparisons of Statistics on Technology Trade.)

Sources: Survey Report of S&T Research (Management and Coordination Agency)
Balance of Monthly Report of International Payments Statistics (Bank of Japan)

Chart 5-2 Breakdown of Japan's Technology Trade, by Country (FY90)

Looking at the individual amounts of Japan's technology trade with other countries, there continue to be significantly more imports from Europe and the United States than exports, and significantly more exports to Asian countries than imports. In FY90, the United States accounted for about 30% of Japan's technology exports and about 70% of its technology imports.

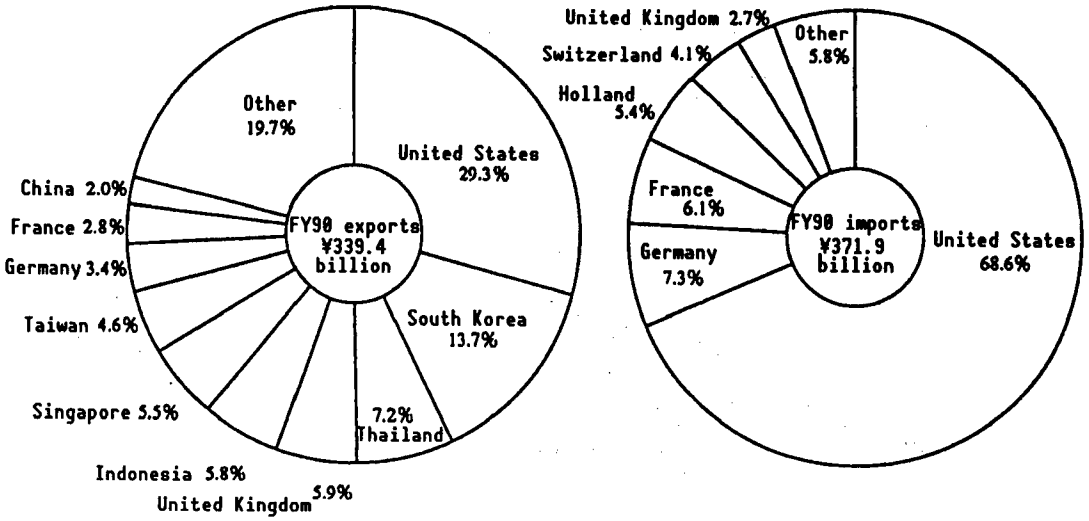
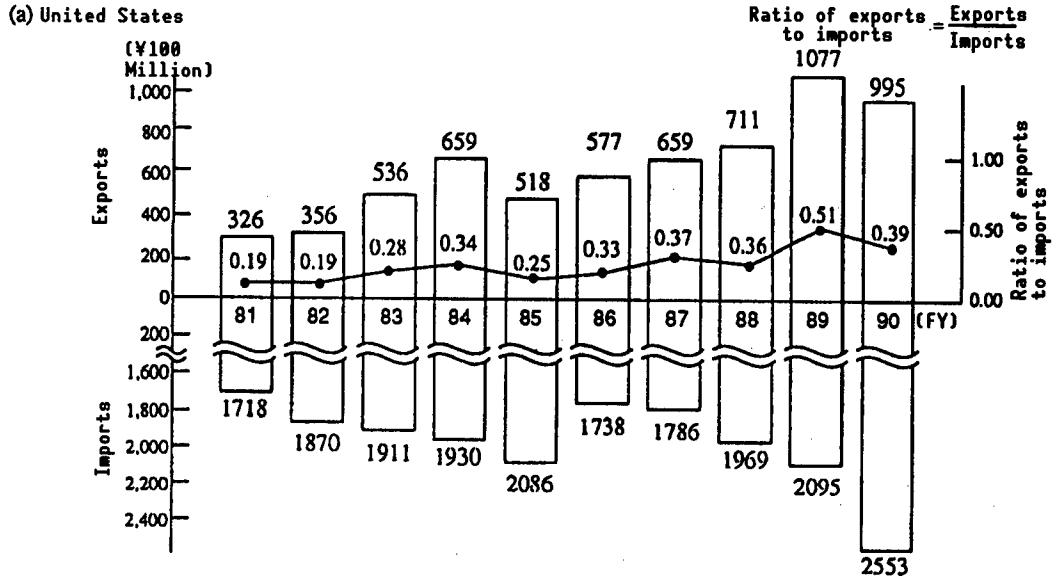
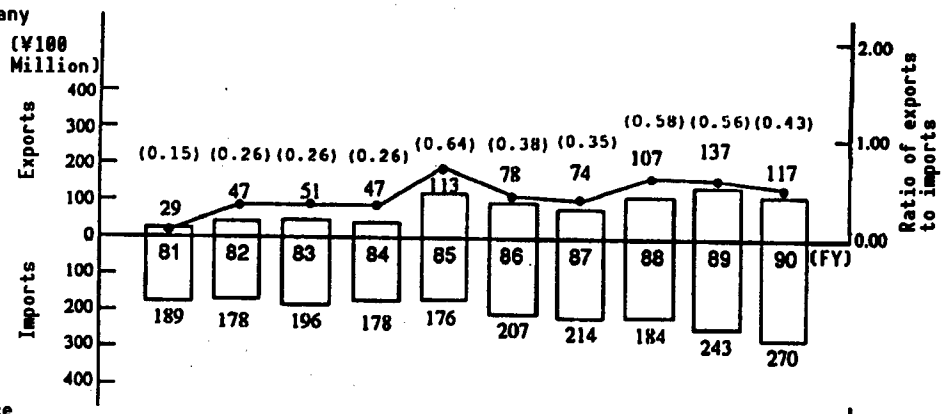


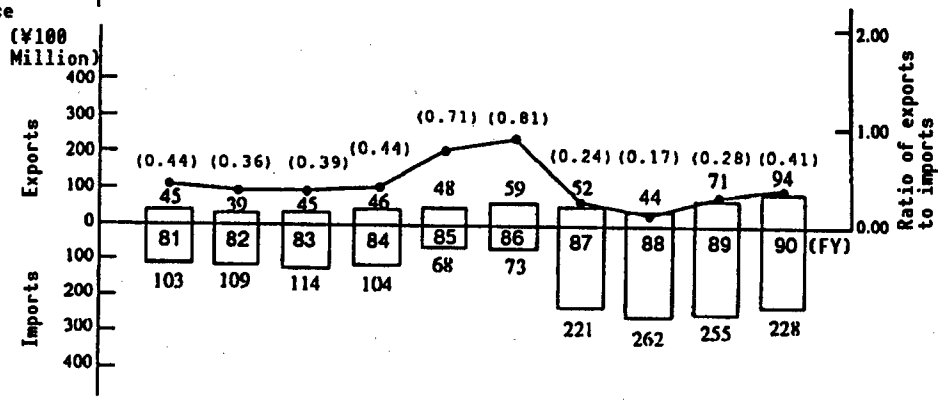
Chart 5-3 Change in Amounts of Japan's Technology Trade, by Country



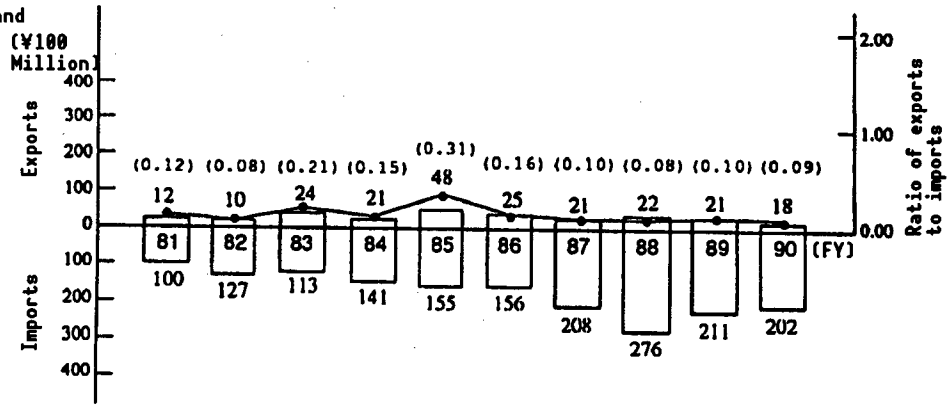
(b) Germany



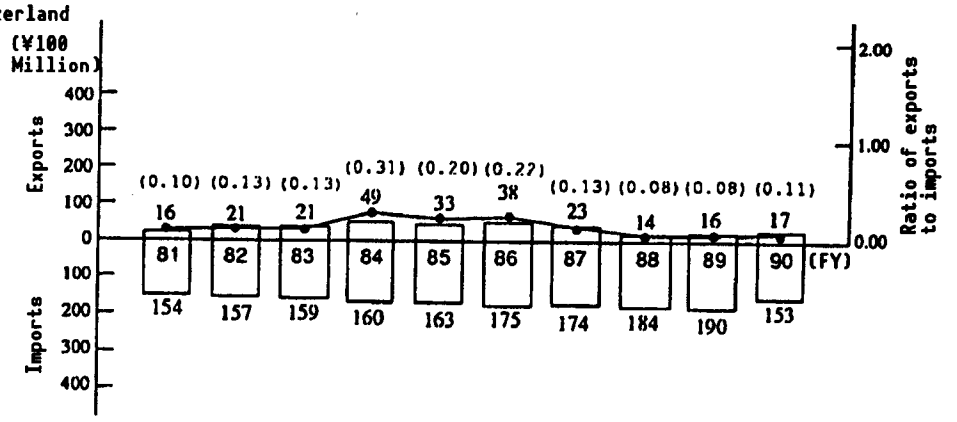
(c) France



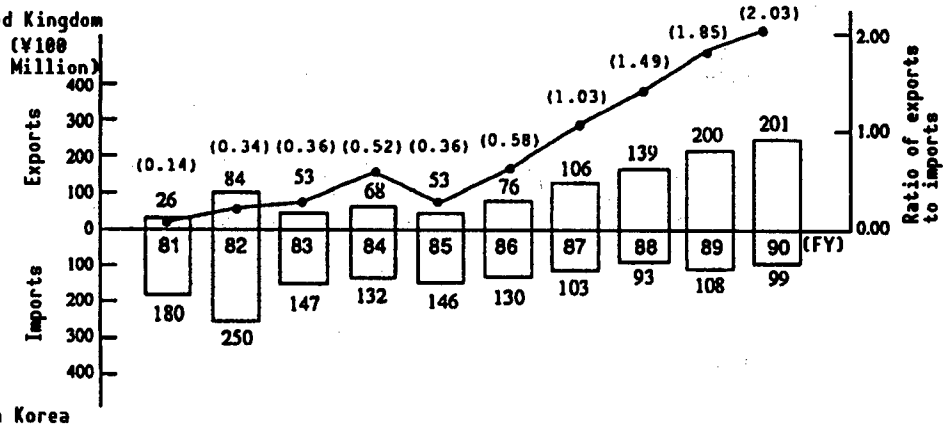
(d) Holland



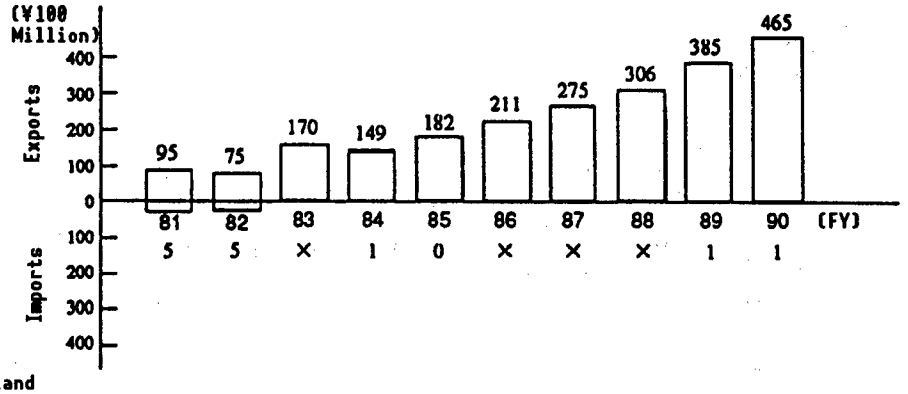
(e) Switzerland



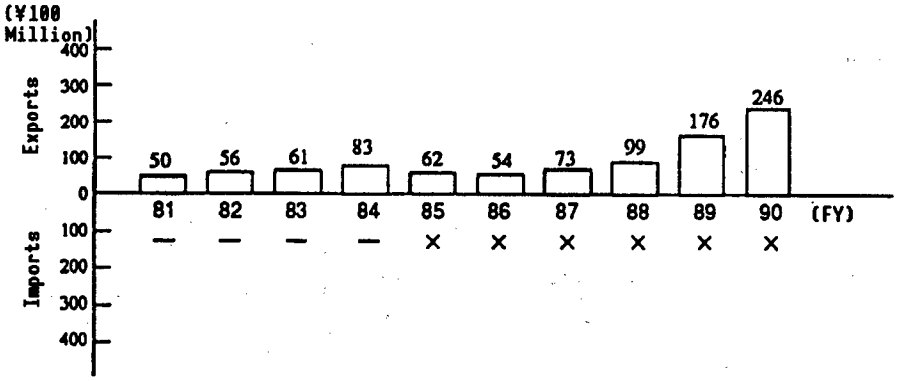
(f) United Kingdom



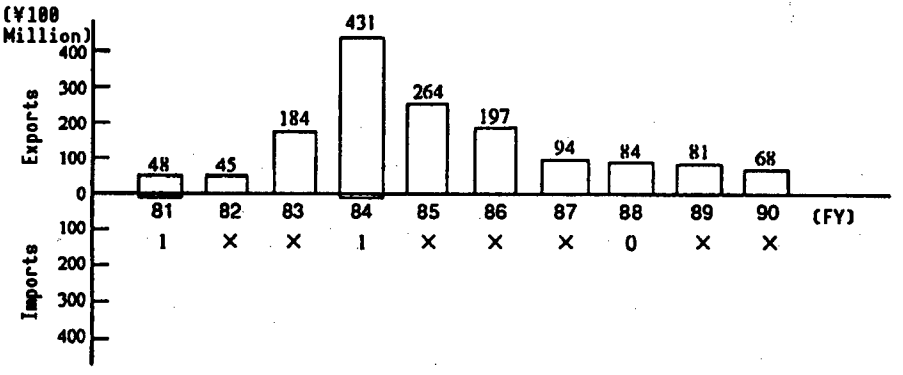
(g) South Korea



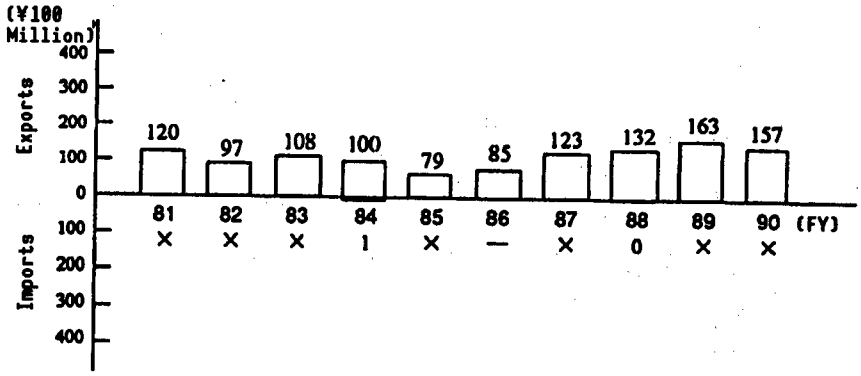
(h) Thailand



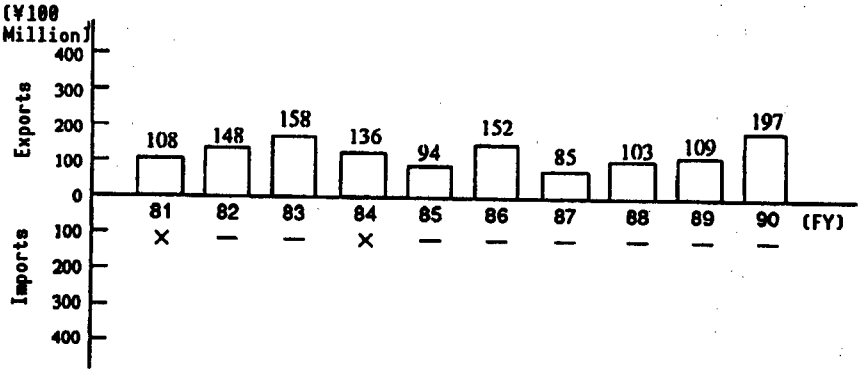
(i) China



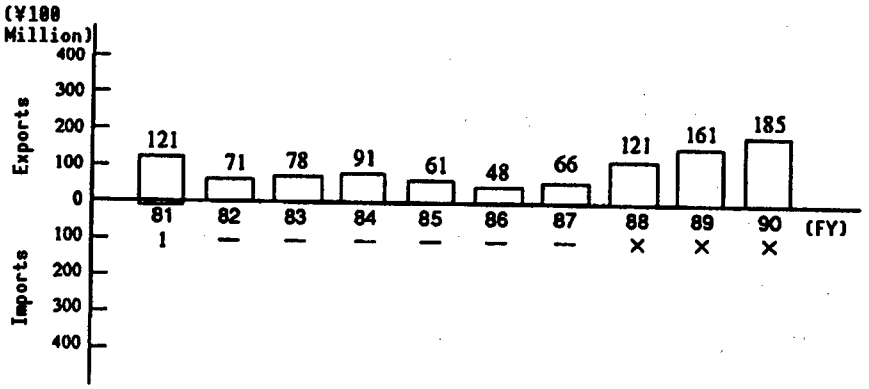
(j) Taiwan



(k) Indonesia



(l) Singapore



Note: "X" indicates "not published",
"—" indicates that there is no corresponding number.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 5-4 Changes in Japan's Technology Trade, by Type of Industry

There continue to be more exports than imports in the automobile (11.70) and construction (9.39) industries. Although there were more exports than imports in industries such as pulp and paper, ceramics, iron and steel, and synthetic chemicals, overall there still continues to be an excess of imports over exports in many types of industries.

Item / FY / Industry category	Technology exports (¥100 Million)				Technology imports (¥100 Million)				Ratio of technology exports to imports			
	1987	88	89	90	1987	88	89	90	1987	88	89	90
All industries	2,156	2,463	3,293	3,394	2,832	3,122	3,299	3,719	0.76	0.79	1.00	0.91
Construction	128	168	124	169	9	10	20	18	13.71	17.39	6.09	9.39
Manufacturing	2,008	2,286	3,162	3,207	2,810	3,095	3,269	3,683	0.71	0.74	0.97	0.87
Food	50	58	83	80	98	134	85	86	0.51	0.43	0.98	0.93
Textiles	44	44	46	39	37	49	48	47	1.19	0.89	0.96	0.83
Pulp, paper	4	5	6	10	5	8	13	5	0.81	0.66	0.42	2.00
Publishing, printing	1	4	4	5	6	9	16	26	0.23	0.39	0.28	0.19
Chemical industry	393	481	536	582	406	503	569	540	0.97	0.96	0.94	1.08
Synthetic chemicals and fibers	189	271	295	277	149	205	232	210	1.27	1.32	1.27	1.32
Oils, fats, and paints	30	31	38	38	37	43	50	36	0.83	0.73	0.77	1.06
Pharmaceuticals	161	163	189	250	136	182	215	225	1.18	0.89	0.88	1.11
Other chemicals	13	16	15	17	84	73	72	69	0.15	0.22	0.20	0.25
Petroleum and coal	3	2	5	2	35	22	38	33	0.09	0.09	0.13	0.06
Plastic	13	13	12	11	9	12	13	22	1.53	1.06	0.87	0.50
Rubber products	31	29	48	51	33	37	38	45	0.95	0.78	1.27	1.13
Ceramics	62	57	90	119	66	37	41	39	0.95	1.53	2.21	3.05
Iron and steel	100	108	216	94	80	79	48	65	1.25	1.37	4.52	1.45
Nonferrous metals	26	20	71	72	107	146	107	139	0.24	0.14	0.66	0.52
Metal	13	11	20	24	29	22	23	24	0.45	0.53	0.88	1.00
Machinery	87	108	132	144	213	226	330	305	0.41	0.48	0.40	0.47
Electrical machinery	611	688	867	970	1,095	1,138	1,206	1,599	0.56	0.60	0.72	0.61
Electrical machinery and appliances	213	210	282	294	345	345	285	374	0.62	0.61	0.99	0.79
Communications, electronics, electrical measuring instruments	398	477	585	677	750	793	920	1,224	0.53	0.60	0.64	0.55
Transport machinery	492	584	871	920	488	520	549	523	1.01	1.12	1.59	1.76
Automobiles	460	542	830	889	84	66	72	76	5.47	8.20	11.46	11.70
Other transport machinery	32	42	41	31	404	454	477	448	0.08	0.09	0.09	0.07
Precision machinery	29	46	126	43	67	73	83	114	0.44	0 63	1.51	0.38
Other types of industries	47	28	29	39	38	81	63	70	1.22	0.34	0.46	0.56
Transportation, communications, and public utilities	9	7	6	8	8	16	7	12	1.09	0.45	0.80	0.67

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 5-5 Breakdown of Technology Trade With the United States, by Type of Industry (FY 90)

In Japan's technology trade with the United States during FY90, the industries that carry a great deal of weight in exports are automobiles (36%); pharmaceuticals (16%); communications, electronics and electrical measuring instruments (12%); electrical machinery and appliances (7%); and synthetic chemicals and fibers (6%). In technology imports, the principal industries are communications, electronics and electrical measuring instruments (39%); transport machinery (14%); electrical machinery and appliances (11%); and machinery (8%). As for the ratio of technology exports to imports, except for the automobile industry (12.56), most of the different types of industries have an excess of technology imports from the United States.

Industry category	Technology exports (¥ Million)		Technology imports (¥ Million)		Exports/Imports (¥ Million)	
	Total	New	Total	New	Total	New
All industries	99,471	10,424	255,225	58,468	0.39	0.18
Construction	109	20	276	129	0.39	0.16
Manufacturing	99,247	10,376	254,320	57,725	0.39	0.18
Food processing	3,175	369	2,789	146	1.14	2.53
Textiles	148	0	572	0	0.26	-
Pulp and paper	384	168	414	2	0.93	84.00
Publishing and printing	266	163	1,974	508	0.13	0.32
Chemical industry	24,265	3,941	32,978	7,485	0.74	0.53
Synthetic chemicals and fibers	6,397	2,255	13,063	3,912	0.49	0.58
Oils, fats, and paints	1,558	11	2,566	0	0.61	-
Pharmaceuticals	15,937	1,575	11,088	3,381	1.44	0.47
Other chemicals	373	100	6,261	192	0.06	0.52
Petroleum and coal products	5	0	1,600	961	0.00	0.00
Plastic products	363	14	1,596	321	0.23	0.04
Rubber products	1,030	10	1,878	1	0.55	10.00
Ceramics	915	56	2,686	184	0.34	0.30
Iron and steel	2,532	847	2,093	970	1.21	0.87
Nonferrous metals	2,201	1,961	3,959	1,001	0.56	1.96
Metal	434	137	569	38	0.76	3.61
Machinery	5,070	437	20,011	2,111	0.25	0.21
Electrical machinery	19,160	1,888	126,847	39,237	0.15	0.05
Electrical machinery and appliances	6,830	901	28,459	7,526	0.24	0.12
Communications, electronics, and electrical measuring instruments	12,330	987	98,388	31,711	0.13	0.03
Transport machinery	36,087	240	39,384	1,704	0.92	0.14
Automobiles	35,556	210	2,830	37	12.56	5.68
Other transport machinery	531	30	36,554	1,667	0.01	0.02
Precision machinery	1,617	103	10,610	2,693	0.15	0.04
Other types of industries	1,595	42	4,360	363	0.37	0.12
Transportation, communications, and public utilities	0	0	617	617	0.00	0.00

Source: Management and Coordination Agency, Statistics Bureau

Chart 5-6 Changes in Ratio of Technology Trade Exports to Imports With the United States, by Type of Industry

In the balance of technology trade with the United States, Japan still continues to import much more than it exports. The automobile, pharmaceuticals, iron and steel, and food industries have an excess of technology exports from the United States, but the other industries have significantly more technology imports than exports.

As for new contracts, the ratios vary widely depending on the year. In FY90, a significant excess of exports in the pulp and paper (84.00) and rubber (10.00) industries stands out.

Item / Industry category / FY	Ratio of technology exports to imports ($\frac{\text{Technology exports}}{\text{Technology imports}}$)											
	Total						New					
	85	86	87	88	89	90	85	86	87	88	89	90
All industries	0.25	0.33	0.37	0.36	0.51	0.39	0.30	0.33	0.35	0.17	0.75	0.18
Construction	0.05	0.04	0.13	0.77	0.07	0.39	0.21	×	×	1.20	0.07	0.16
Manufacturing	0.25	0.33	0.37	0.36	0.52	0.39	0.31	0.33	0.35	0.16	0.78	0.18
Food processing	0.99	0.53	0.73	0.36	1.56	1.14	×	×	×	0.14	8.81	2.53
Textiles	0.61	0.49	0.86	0.27	0.45	0.26	×	0.02	×	0.09	4.14	-
Pulp and paper	0.17	0.26	0.23	0.33	0.20	0.93	×	×	×	0.00	-	84.00
Publishing and printing	×	×	×	0.08	0.07	0.13	0.00	0.00	×	0.16	0.05	0.32
Chemical industry	0.53	0.50	0.54	0.72	0.73	0.74	1.14	0.25	0.88	1.43	0.94	0.53
Synthetic chemicals and fibers	0.49	0.35	0.43	0.43	0.61	0.49	0.61	0.23	0.45	0.92	2.22	0.58
Oils, fats, and paints	0.29	0.32	0.34	0.35	0.63	0.61	1.69	5.38	×	2.52	1.27	-
Pharmaceuticals	1.29	1.48	1.55	2.05	1.43	1.44	370.50	×	2.09	0.11	0.08	0.47
Other chemicals	0.07	0.04	0.04	0.10	0.09	0.06	0.00	0.04	0.97	11.75	10.00	0.52
Petroleum and coal products	0.00	×	×	0.00	0.00	0.00	0.00	×	×	0.00	0.00	0.00
Plastic products	0.22	0.33	×	0.54	0.45	0.23	×	×	×	0.49	0.18	0.04
Rubber products	0.21	0.14	0.37	0.41	0.55	0.55	×	×	×	0.17	0.45	10.00
Ceramics	0.03	0.17	0.23	0.24	0.21	0.34	0.14	×	4.63	0.18	0.30	0.30
Iron and steel	1.78	1.20	0.74	0.37	2.70	1.21	10.35	1.27	0.62	0.22	6.16	0.87
Nonferrous metals	0.09	0.15	0.06	0.04	1.33	0.56	0.14	7.36	×	0.27	6.39	1.96
Metal	0.17	0.04	0.07	0.12	0.37	0.76	×	×	×	0.13	0.12	3.61
Machinery	0.19	0.18	0.16	0.26	0.22	0.25	0.45	0.50	0.14	0.64	0.21	0.21
Electrical machinery	0.21	0.21	0.23	0.21	0.23	0.15	0.20	0.25	0.21	0.04	0.39	0.05
Electrical machinery and appliances	0.19	0.17	0.29	0.27	0.45	0.24	0.55	0.09	0.84	0.04	0.93	0.12
Communications, electronics, and electrical measuring instruments	0.22	0.23	0.19	0.18	0.17	0.13	0.14	0.40	0.08	0.05	0.26	0.03
Transport machinery	0.20	0.51	0.75	0.62	0.93	0.92	0.03	0.72	0.43	0.03	0.95	0.14
Automobiles	1.41	3.56	6.23	7.30	15.56	12.56	×	2.17	×	1.39	26.65	5.68
Other transport machinery	0.01	0.02	0.04	0.01	0.02	0.01	×	×	0.52	0.00	0.02	0.02
Precision machinery	0.07	0.12	0.13	0.19	0.95	0.15	×	×	0.00	0.04	0.04	0.04
Other types of industries	1.51	1.02	1.32	0.31	0.30	0.37	0.01	0.13	×	0.00	0.28	0.12
Transportation, communications, and public utilities	0.19	×	0.02	0.22	0.10	0.00	0.03	0.00	×	0.36	0.05	0.00

Notes: • "Plastic products" were noted as a new type of industry in FY84; prior to that they were included under "other industries."
• "X" indicates "not published" (the number of contracts is four or less), "–" indicates that there is no corresponding number.

Source: Survey Report of S&T Research Management (Management and Coordination Agency

Chart 5-7 Change in Technology Trade of Principal Countries

Looking at the balance of technology trade among the principal countries, only the United States continues to have an excess of exports, and the United Kingdom's technology trade changed after 1987 from an excess of exports to an excess of imports. Japan, Germany, and France have more technology imports than exports.

Year	Japan			United States			United Kingdom			France			Germany		
	Exports	Imports	Export/import ratio	Exports	Imports	Export/import ratio	Exports	Imports	Export/import ratio	Exports	Imports	Export/import ratio	Exports	Imports	Export/import ratio
1970	N.A	N.A	N.A	8,347	802	10.41	978	913	1.07	243	717	0.34	426	1,096	0.39
1971	272	1,345	0.20	8,890	842	10.56	1,002	938	1.07	237	796	0.30	518	1,313	0.39
1972	422	1,739	0.24	8,399	891	9.42	1,026	930	1.10	256	857	0.30	610	1,314	0.46
1973	508	1,733	0.29	8,762	1,046	8.38	1,113	951	1.17	376	1,073	0.35	586	1,462	0.40
1974	571	1,598	0.36	11,161	1,011	11.04	1,358	1,207	1.12	450	1,170	0.38	766	1,703	0.45
1975	666	1,691	0.39	12,762	1,401	9.11	1,463	1,437	1.02	380	1,526	0.38	913	2,163	0.42
1976	834	1,773	0.47	12,911	1,430	9.03	1,782	1,416	1.26	608	1,731	0.35	857	2,056	0.42
1977	933	1,901	0.49	13,210	1,353	9.76	1,698	1,390	1.22	762	1,466	0.52	900	2,191	0.41
1978	1,220	1,921	0.64	12,382	1,412	8.77	1,567	1,317	1.19	730	1,427	0.51	905	2,029	0.45
1979	1,331	2,410	0.55	13,549	1,821	7.44	1,771	1,474	1.20	936	1,764	0.53	1,077	2,334	0.46
1980	1,596	2,395	0.67	16,062	1,641	9.79	2,163	1,867	1.16	1,125	2,328	0.48	1,261	2,593	0.49
1981	1,751	2,596	0.67	16,061	1,433	11.21	2,147	1,775	1.21	1,087	2,084	0.52	1,069	2,091	0.51
1982	1,849	2,826	0.65	12,896	1,537	8.39	2,189	1,805	1.21	938	2,250	0.42	1,226	2,259	0.54
1983	2,409	2,793	0.86	12,531	1,717	7.30	2,216	1,737	1.27	1,403	2,172	0.65	1,221	2,308	0.53
1984	2,775	2,814	0.99	13,369	2,268	5.89	2,431	2,320	1.09	1,021	2,094	0.49	1,229	2,162	0.57
1985	2,342	2,932	0.80	14,298	2,125	6.73	2,501	2,223	1.22	1,215	2,335	0.52	1,301	2,373	0.55
1986	2,241	2,606	0.86	12,223	1,789	6.83	2,035	2,131	1.08	1,152	2,076	0.55	1,312	2,622	0.50
1987	2,156	2,832	0.76	13,101	2,048	6.40	2,226	2,425	0.92	1,291	2,298	0.56	1,344	2,719	0.49
1988	2,463	3,122	0.79	13,905	2,724	5.10	2,393	2,609	0.92	1,463	2,858	0.51	1,381	2,797	0.49
1989	3,293	3,299	1.00	16,469	2,978	5.53	–	–	–	1,430	2,477	0.58	1,589	2,968	0.54
1990	3,394	3,719	0.91	22,141	3,829	5.78	–	–	–	–	–	–	–	–	–

Note: The data for Japan are "fiscal year" totals.

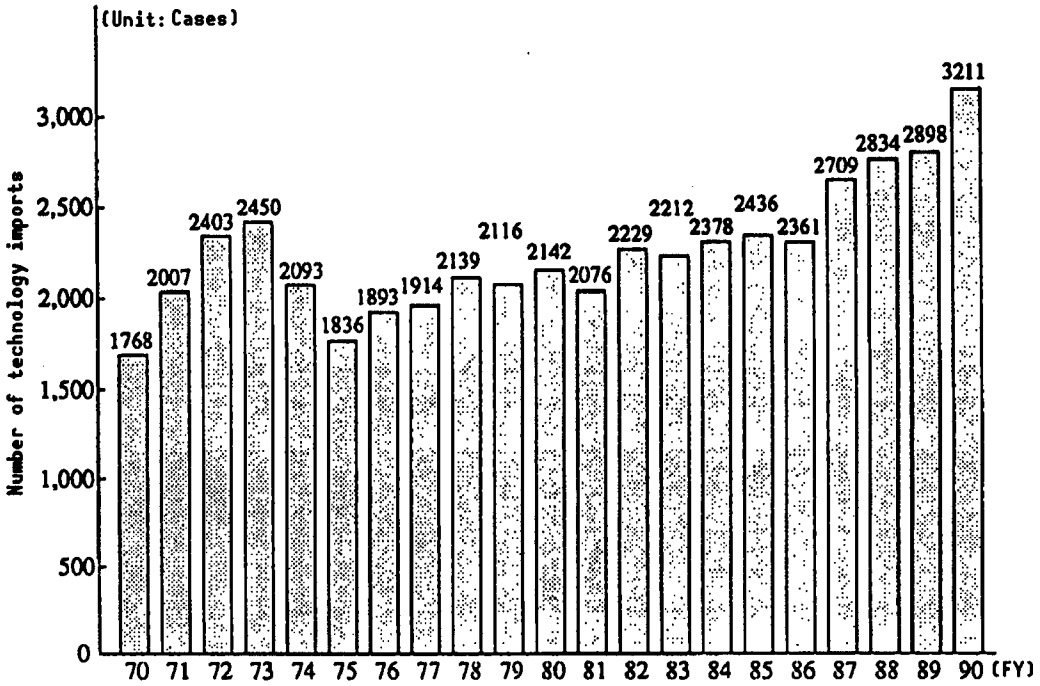
Sources: Japan: Management and Coordination Agency (Survey Report of S&T Research)
United States: Department of Commerce (Survey of Current Business)*
United Kingdom: Department of Trade and Industry "Business Monitor, Overseas Transactions" (1970–83), Central Statistical Office Data (after 1984, includes oil industry)*
Germany: Deutschen Bundesbank "Monatsberichte der Deutschen Bundesbank]*
France: Ministere de l'Econmie, des Finance et du Budget [Statistique & Etudes Financieres", "La Balance des Paiements de la France"*

* Quoted from the S&T White Paper

6. Trends in Technology Imports

Chart 6-1 Change in Japan's Technology Imports

After the early 1950s Japan's imports of new technology tended to increase, but that hit a temporary peak in FY73 and then declined. New technology imports started increasing again after FY75, and now that trend continues.

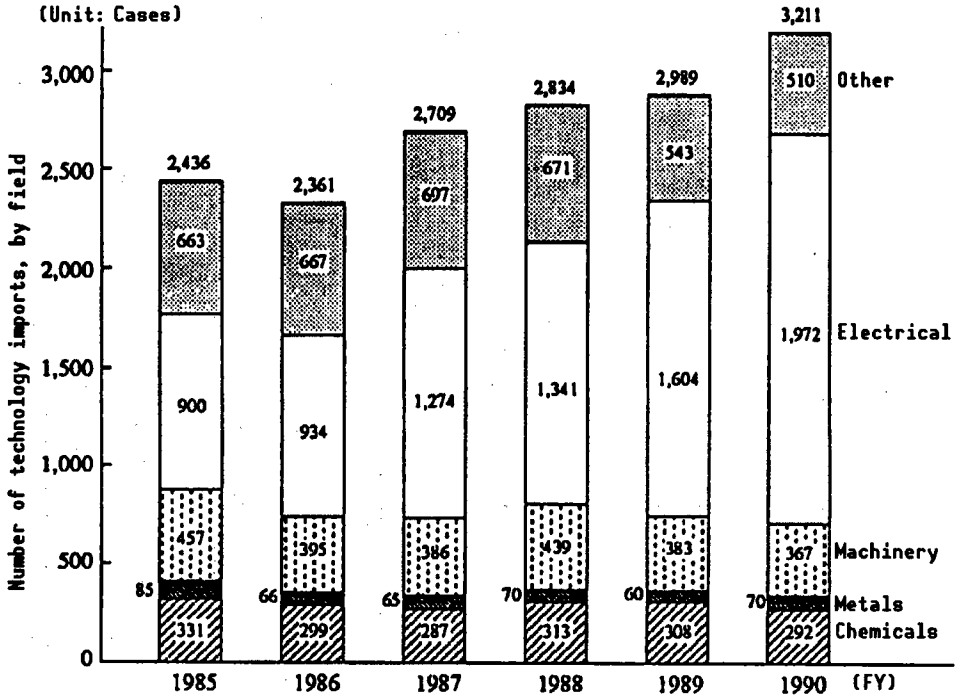


Note: The foreign technology import totals are based on the records of technology import contracts that were reported in accordance with laws such as the Foreign Exchange Foreign Trade Control Law (revised in December 1979).

Source: Analysis of Trends in Foreign Technology Imports (Science and Technology Agency, S&T Policy Institute)

Chart 6-2 Changes in Technology Imports, by Field

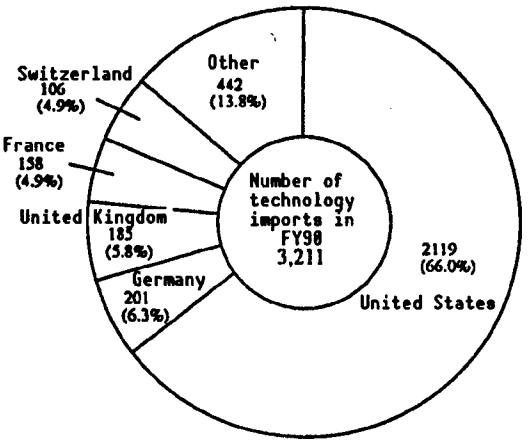
Looking at the number of cases of technology imports by the technology area, electrical fields show a gradual increase in the number of technology imports, but there tend to be no significant fluctuations in machinery, metals, and chemicals technology imports.



Source: Analysis of Trends in Foreign Technology Imports (Science and Technology Agency, S&T Policy Institute)

Chart 6-3 Breakdown of Technology Imports, by Country

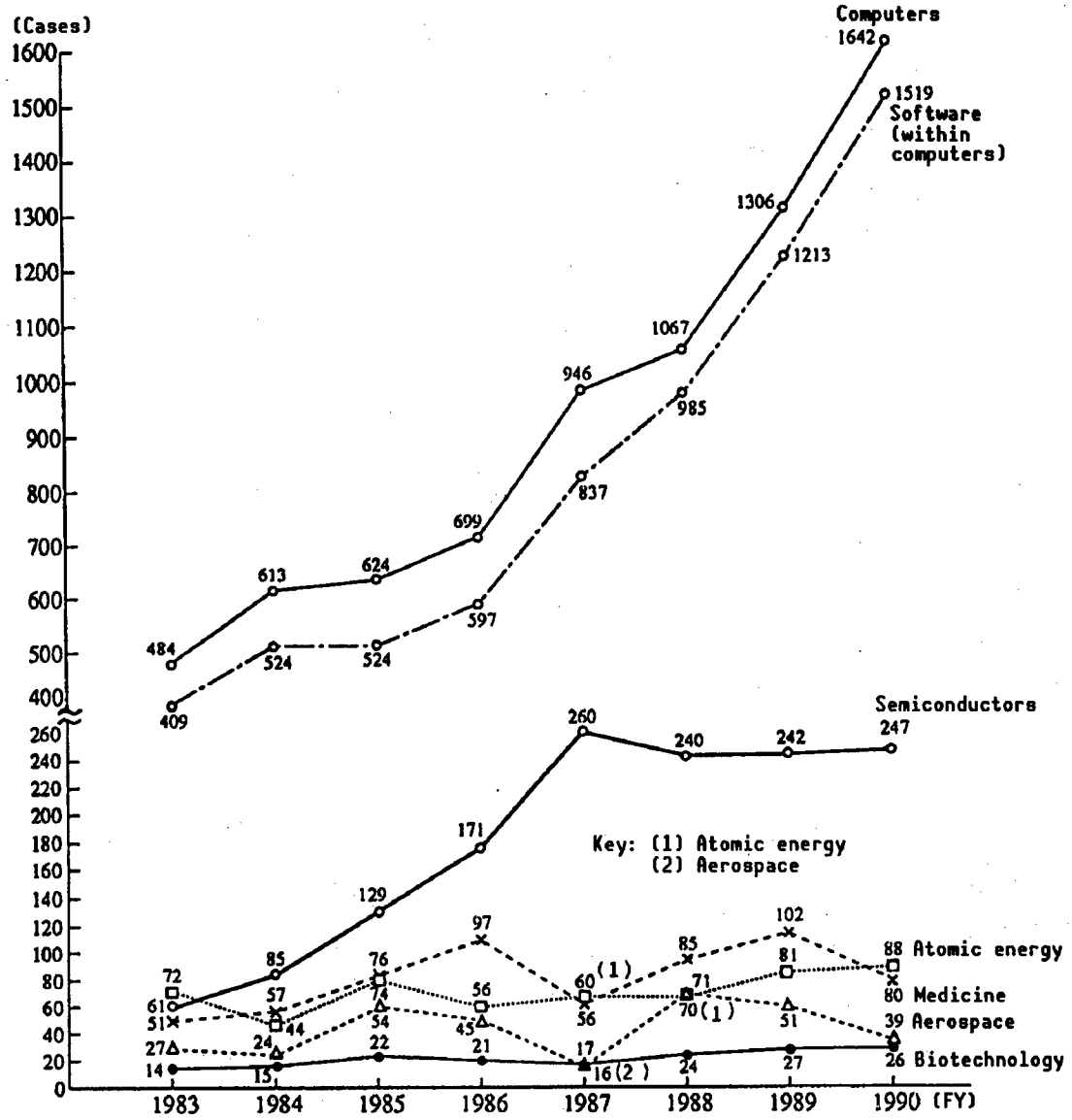
Looking at the number of cases of technology imports in FY90 by country, the top five countries—the United States, Germany, the United Kingdom, France, and Switzerland—account for 86.2% of all Japan's technology imports from other countries.



Source: Analysis of Trends in Foreign Technology Imports (Science and Technology Agency, S&T Policy Institute)

Chart 6-4 Changes in High-Tech Imports

Of the technology imports involving advanced technologies,software imports have been increasing remarkably from year to year. In FY90 there were 1,519 cases of software imports, accounting for 47.3% of the total number of import contracts.

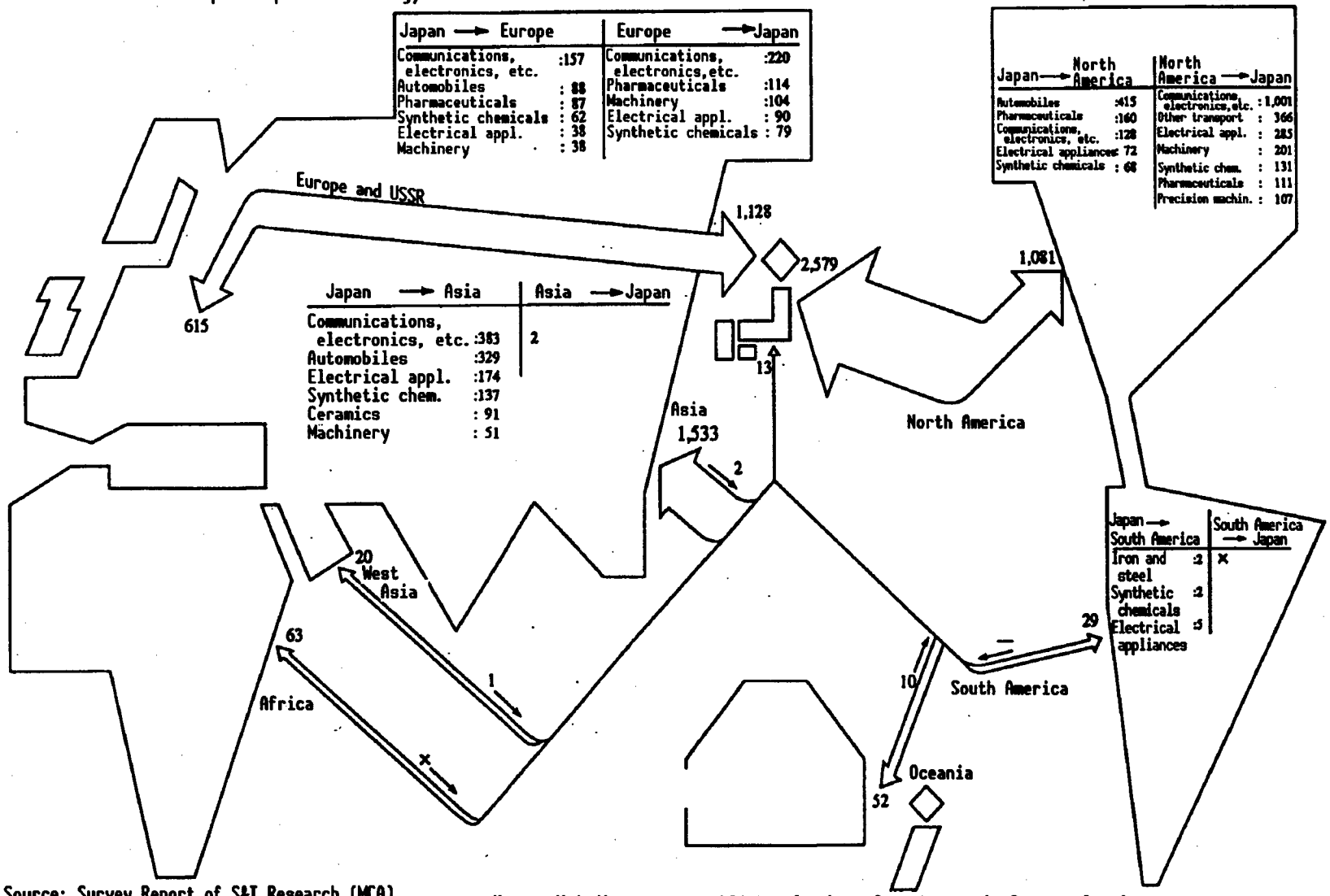


Notes: • The number of cases include those that are noted twice when the technology straddles more than one high-tech field.
• Although there is no clear definition of high-tech, the focus was on the fields of technology for which there is a great deal of interest lately. Incidentally, data for robots, new materials, and other such items whose technology range cannot be specified were left out.

Source: Analysis of Trends in Foreign Technology Imports (Science and Technology Agency, S&T Policy Institute)

Chart 6-5 World Map of Japan's Technology Trade (FY90)

(Unit: ¥100 million)



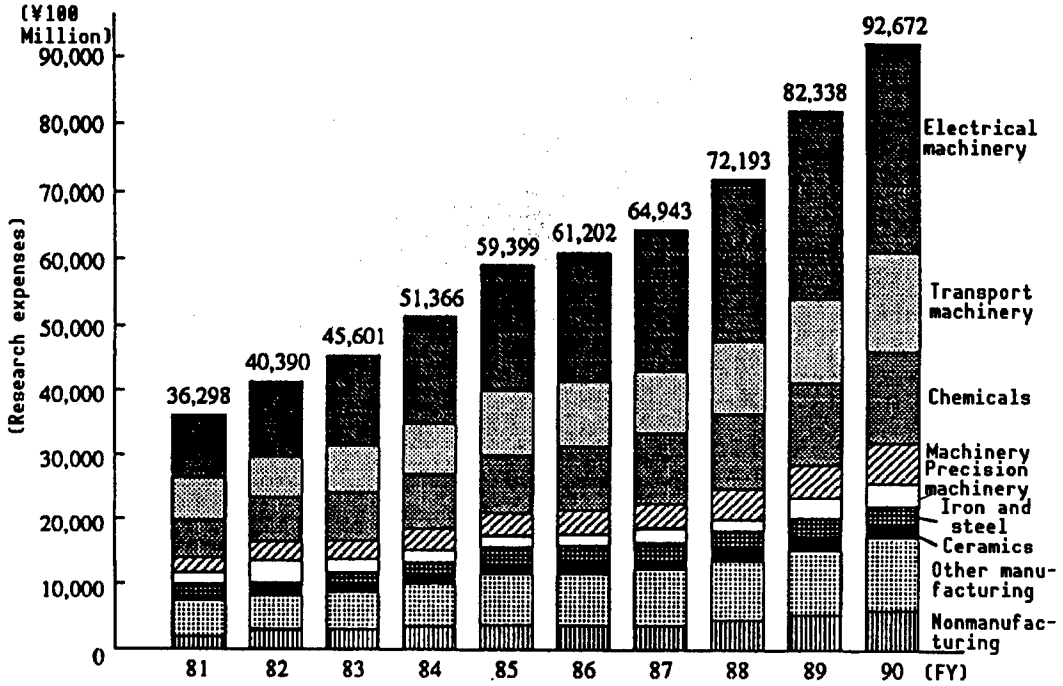
Source: Survey Report of S&T Research (MCA)

Notes: X indicates not published (number of contracts is four or less)
-- indicates there is no corresponding number

7. R&D Trends, by Type of Industry

Chart 7-1 Change in Japan's Research Expenses, by Type of Industry

Looking at FY90 research expenses by the type of industry, the electrical machinery industry accounted for ¥3.1463 trillion, or one-third of all of industry's research expenses. That is followed by the transport machinery industry, with ¥1.4961 trillion in research expenses, and the chemicals industry, with ¥1.4168 trillion. These top three industries account for two-thirds of all of industry's research expenses.



Reference Table Change in Japan's Research Expenses, by Type of Industry

(Unit: ¥100 Million)

FY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Electrical machinery	10,062	11,764	14,162	16,345	19,382	19,800	21,635	24,516	28,081	31,463
Transport machinery	6,274	6,719	7,145	8,082	9,357	9,898	9,696	10,864	12,446	14,961
Chemicals	6,174	6,875	7,745	8,528	9,364	9,836	10,959	11,902	13,139	14,168
Machinery	2,421	2,810	3,117	3,375	3,827	3,791	4,188	4,510	5,590	6,503
Precision machinery	1,268	1,342	1,588	1,674	2,017	1,992	2,042	2,388	2,661	3,358
Iron and steel	1,697	1,828	1,861	1,921	2,404	2,553	2,452	2,497	2,681	3,038
Ceramics	841	936	1,133	1,313	1,742	1,876	1,779	1,986	2,214	2,153
Other manufacturing	5,005	5,281	5,821	6,527	7,343	7,650	8,261	8,883	10,250	10,959
Nonmanufacturing	2,556	2,835	3,029	3,601	3,963	3,806	3,931	4,647	5,276	6,069

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 7-2 Breakdown of Research Expenses in Principal Countries, by Type of Industry

A look the at the by-industry breakdown of research expenses in principal countries shows that the electrical machinery and transport machinery industries account for the largest shares of research expenses in each country. In Germany, France and the United Kingdom, the synthetic chemicals industry also accounts for a large share.

(Units: Research expenses: ¥100 million; component ratio: %)

Country / Industry / FY	Japan		United States		Germany		France		United Kingdom	
	1990		1988		1987		1988		1988	
All industries	92,672	(100.0)	127,459	(100.0)	35,633	(100.0)	19,335	(100.0)	15,663	(100.0)
Chemical	14,168	(15.3)	13,812	(10.8)	7,303	(20.5)	-	(-)	3,592	(22.9)
Chemical products	5,874	(6.3)	5,075	(4.0)	-	(-)	8,447	(43.7)	1,709	(10.9)
Pharmaceuticals	5,161	(5.6)	6,073	(4.8)	-	(-)	1,775	(9.2)	1,883	(12.0)
Iron and steel, non-ferrous metals	4,445	(4.8)	850	(0.7)	634	(1.8)	359	(1.9)	-	(-)
Iron and steel	3,038	(3.3)	333	(0.3)	214	(0.6)	-	(-)	-	(-)
Machinery	6,503	(7.0)	-	(-)	3,672	(10.3)	525	(2.7)	687	(4.4)
Electrical machinery	31,463	(34.0)	21,466	(16.8)	10,080	(28.3)	5,428	(28.1)	5,047	(32.2)
Transport machinery	14,961	(16.1)	46,439	(36.4)	-	(-)	-	(-)	-	(-)
Automobiles	12,956	(14.0)	-	(-)	5,612	(15.7)	1,921	(9.9)	1,069	(6.8)
Aircraft, etc.	-	(-)	32,905	(25.8)	2,076	(5.8)	3,726	(19.3)	1,858	(11.9)
Precision machinery	3,358	(3.6)	7,129	(5.6)	497	(1.4)	223	(1.2)	-	(-)
Nonmanufacturing	6,069	(6.5)	11,176	(8.8)	2,064	(5.8)	1,974	(10.2)	2,257	(14.4)

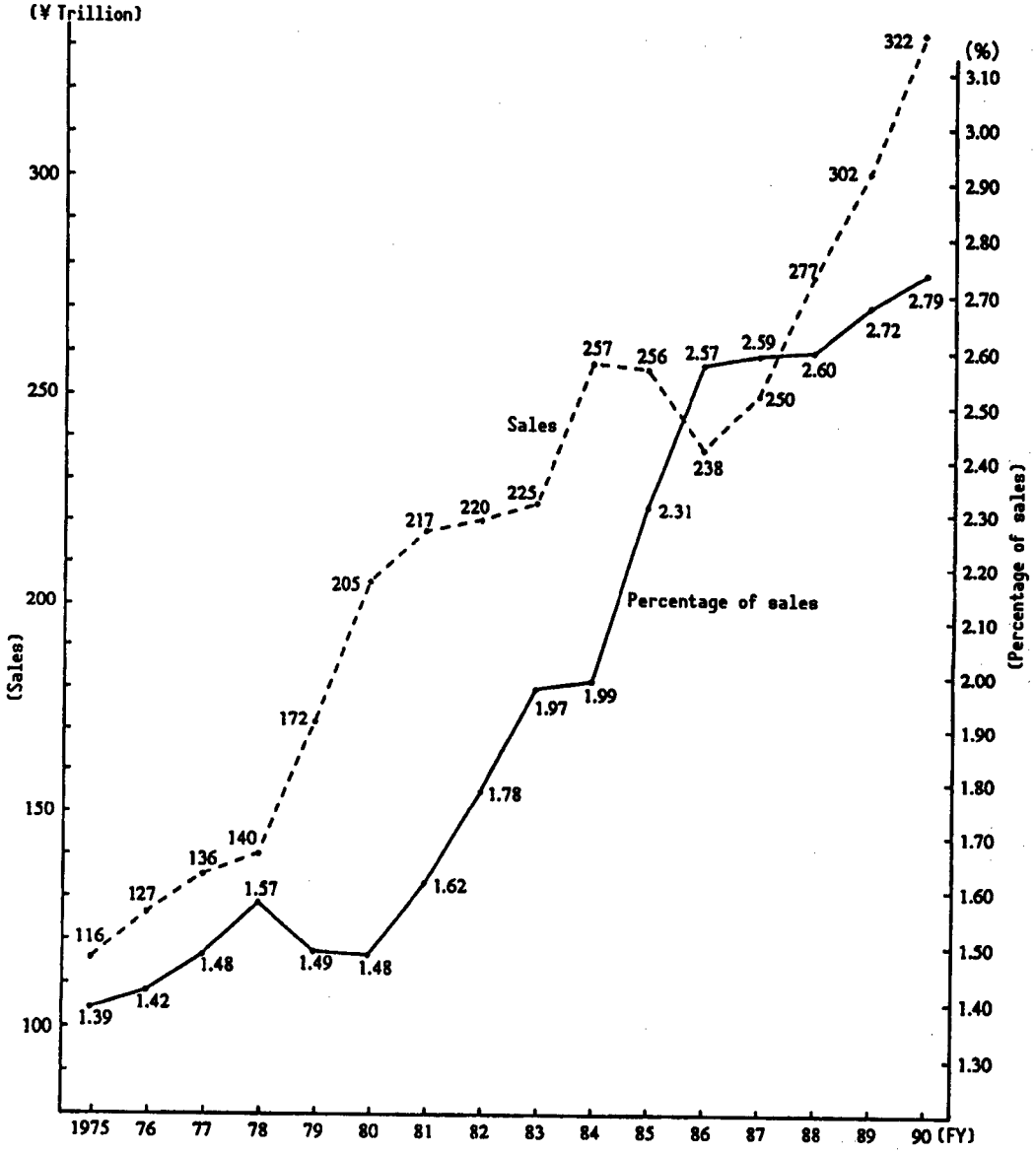
Note: The figures within parentheses show the component ratios.

Sources: Japan: Survey Report of S&T Research (Management and Coordination Agency)
United States: NSF (National Patterns of R&D Resources 1989, 1990)*
Germany: BMFT (Bundesbericht Forschung 1988)*
France: Ministry of Research and Technology (Recherche et Developpement Dans les Enterprises)*
United Kingdom: Industrial Research Development Expenditure and Employment: 1988 *

* Quoted from the Survey of S&T

Chart 7-3 **Change in Japanese Firms' Research Expenses as a Percentage of Sales**

The FY90 research expenses of Japanese firms as a percentage of their sales was 2.79%. Although the rate of that growth differs from year to year, since FY81 there has tended to be a successive rise in firms' research expenses with respect to sales.



Note: "Percentage of sales" means the research expenses divided by the sales; special corporations are not included.
"Sales" means the total amount of sales of firms that conduct research.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 7-4 Changes in Japanese Firms' Research Expenses as Percentages of Sales and Operating Profits, by Type of Industry

Firms' research expenses as a percentage of sales in FY90 stayed at about the same level as that of the previous year for all the different industries. The following industries showed high percentages: pharmaceuticals (8.02%), precision machinery (5.94%), and electrical machinery and appliances (5.36%). Although there are large fluctuations from year to year in firms' research expenses as a percentage of operating profits, overall it is high for industries such as automobiles and communications, electronics, and electrical measuring instruments.

(Unit : %)

Item / FY / Industry	Percentage of sales					Percentage of profits				
	1986	87	88	89	90	1986	87	88	89	90
All industries	2.57	2.59	2.61	2.72	2.79	54.8	47.0	42.8	46.5	49.9
Agriculture, forestry, and fisheries	0.24	0.31	0.38	0.21	0.50	16.8	41.0	41.5	24.3	54.4
Mining	1.16	1.01	1.58	1.17	1.36	133.0	33.4	28.1	18.6	27.1
Construction	0.55	0.51	0.5	0.53	0.56	19.0	15.5	13.9	12.7	12.0
Manufacturing	3.03	3.14	3.15	3.29	3.36	83.3	68.4	57.9	60.3	64.2
Food processing	0.85	0.99	0.89	1.07	0.98	19.4	22.1	22.8	32.8	18.7
Textiles	1.23	1.42	1.50	1.71	1.76	28.6	30.2	32.3	33.1	42.3
Pulp and paper	0.80	0.77	0.87	0.79	0.88	11.7	11.7	12.3	13.3	18.1
Publishing and printing	0.64	0.80	0.63	0.71	0.88	14.4	14.7	11.2	13.0	13.6
Chemical industry	4.31	4.53	4.63	4.84	4.89	65.2	58.9	56.8	62.1	71.6
Synthetic chemicals and fibers	3.56	3.76	3.92	4.09	4.01	63.8	55.4	52.2	57.3	68.6
Oils, fats, and paints	3.42	3.85	3.74	3.93	3.90	69.5	72.0	70.9	77.2	78.6
Pharmaceuticals	6.89	6.96	6.94	7.50	8.02	70.8	62.4	61.1	70.7	85.5
Other chemicals	3.87	4.00	4.11	4.11	4.06	55.1	54.2	54.3	51.4	50.8
Petroleum and coal products	0.62	0.64	0.83	0.72	0.64	29.3	22.9	22.6	26.2	23.2
Plastic products	2.09	2.16	2.21	2.73	2.37	50.7	43.9	44.7	57.5	55.0
Rubber products	2.92	3.25	3.19	3.25	3.20	64.9	57.2	55.3	51.9	51.0
Ceramics	2.87	2.82	2.73	2.75	2.60	45.0	37.3	33.7	36.7	40.0
Iron and steel	2.54	2.40	2.13	2.21	2.33	334.3	40.6	21.0	22.3	30.2
Nonferrous metals	2.11	1.90	2.00	1.91	1.80	63.5	50.7	45.9	44.9	40.8
Metal	1.61	1.50	1.48	1.36	1.60	31.1	24.0	20.0	19.4	25.3
Machinery	2.77	2.99	2.60	2.83	2.99	75.8	65.6	44.6	41.1	43.2
Electrical machinery	5.50	5.61	5.53	5.89	5.86	188.7	155.0	115.1	114.3	120.3
Electrical machinery and appliances	5.23	5.26	5.25	5.47	5.36	140.0	120.6	99.9	98.1	98.5
Communications, electronics, and electrical measuring instruments	5.63	5.78	5.66	6.10	6.12	224.2	177.5	123.2	123.3	134.0
Transport machinery	3.21	3.22	3.31	3.40	3.65	193.1	138.5	108.2	103.2	110.2
Automobiles	3.20	3.17	3.31	3.48	3.73	146.1	126.6	104.7	108.3	117.2
Other transport machinery	3.28	3.45	3.31	2.93	3.20	-238.1	276.3	135.8	77.9	79.3
Precision machinery	4.59	4.91	4.85	5.16	5.94	139.4	122.1	96.2	79.6	100.1
Other types of industries	1.07	1.12	1.14	1.19	1.21	24.8	23.4	24.3	24.7	21.0
Transportation, communications, and public utilities	0.96	0.84	0.98	1.09	1.10	6.3	5.8	7.0	9.4	11.1

Notes: • "Percentage of sales" means the research expenses divided by sales; special corporations are not included. "Percentage of operating profits" means the research expenses divided by the operating profits.
• "Operating profits" means the amount of gross sales excluding the cost of sales, general management expenses, and selling expenses; special corporations are not included.

Source: Survey Report of S&T Research (Management and Coordination Agency)

Reference Table Research Expenses as a Percentage of Sales for Firms in Japan, United States, and Germany

(Unit: %)

Country / Year	Japan	United States	Germany
	1990	1988	1987
All industries	2.79	4.8	3.8
Chemicals	4.89	5.4	6.1
Chemical products	4.01	4.5	—
Pharmaceuticals	8.02	9.0	—
Iron and steel, nonferrous metals	2.13	0.8	1.0
Iron and steel	2.33	0.6	0.6
Machinery	2.99	—	3.7
Electrical machinery	5.86	8.1	9.4
Transport machinery	3.65	8.9	—
Automobiles	3.73	—	3.9
Aircraft, etc.	—	15.4	27.1
Precision machinery	5.94	7.7	5.7

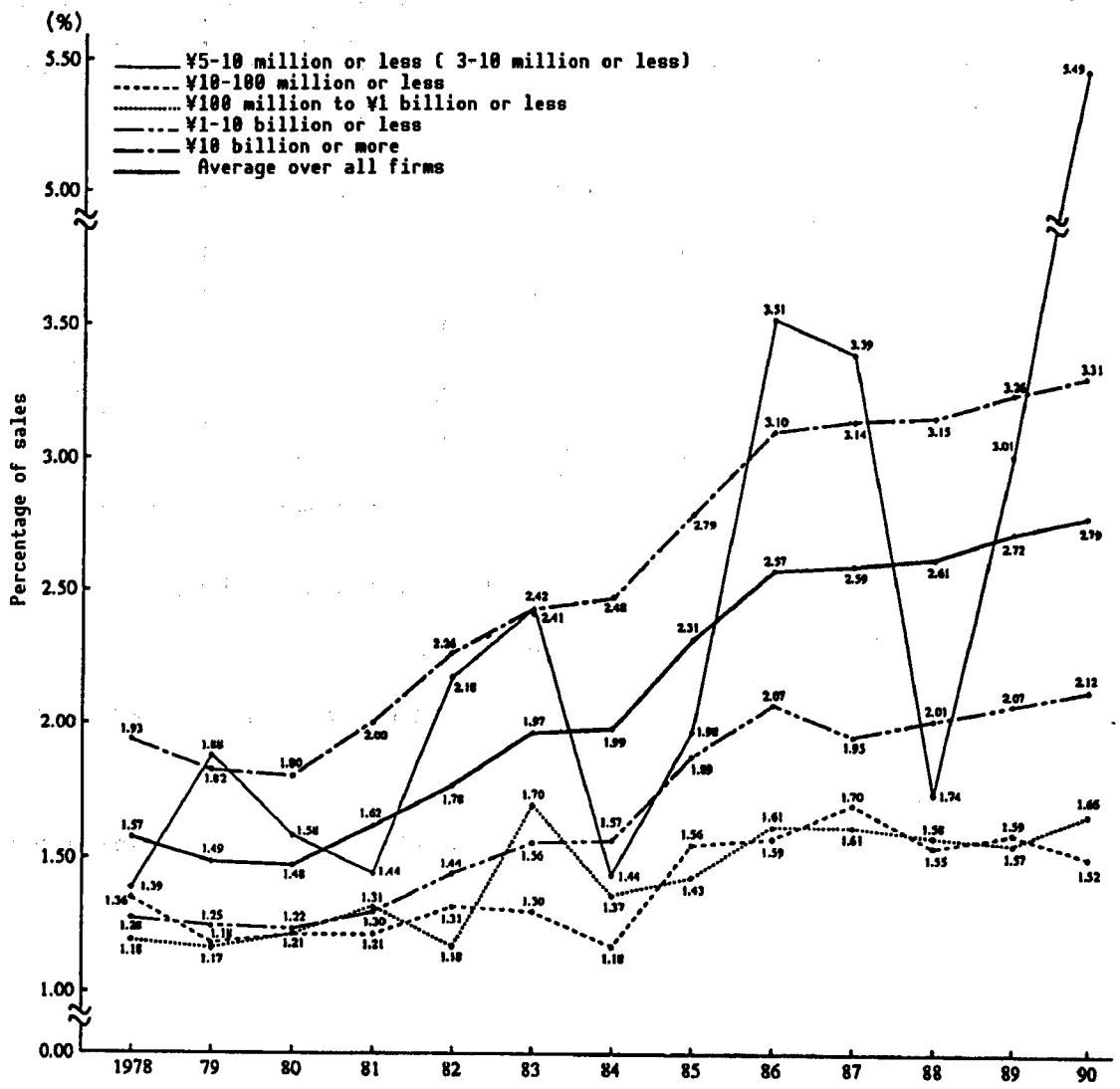
Notes: • "Percentage of sales" means the research expenses divided by the sales.
• The data for Japan are "fiscal year" totals.

Sources: Japan: Survey Report of S&T Research (Management and Coordination Agency)
United States: NSF statistics*
Germany: BMFT data*

* Quoted from the S&T White Paper

Chart 7-5 Change in Japanese Firms' Research Expenses as a Percentage of Sales, by Scale of Capital

As a whole, the research expenses of firms as a percentage of their sales rises as the scale of their capital gets larger. However, there have been considerable fluctuations from year to year in that percentage for firms with ¥5~10 million or less in capital; in FY89 and FY90 it rose dramatically.

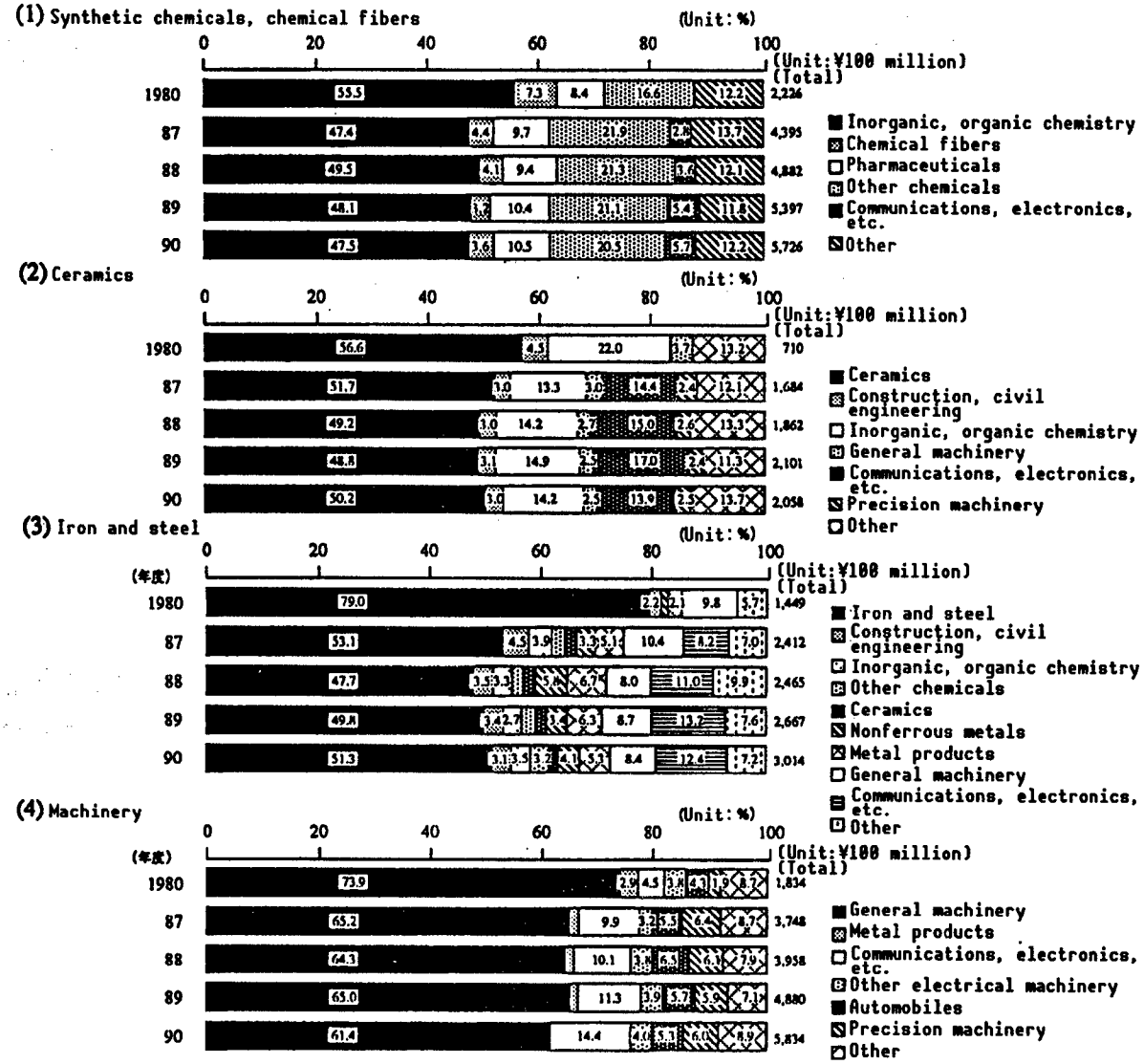


Notes: • "Percentage of sales" means the research expenses divided by the sales; special corporations are not included.
• "¥3-10 million or less" is the scale of capital at which surveys prior to FY78 looked.

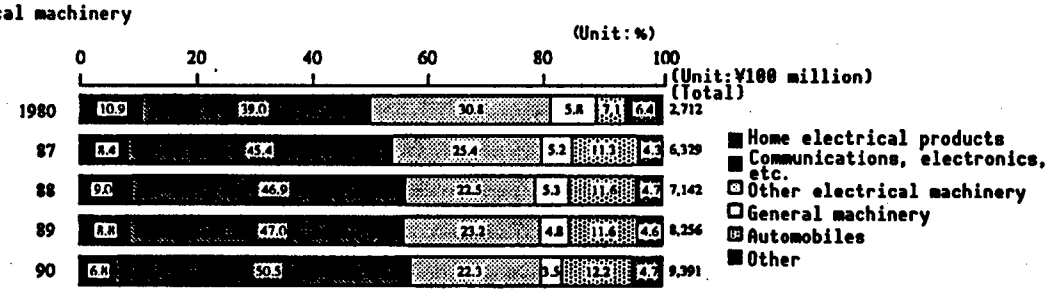
Source: Survey Report of S&T Research (Management and Coordination Agency)

Chart 7-6 Change in Component Ratios of Principal Industries' Research Expenses, by Product Field

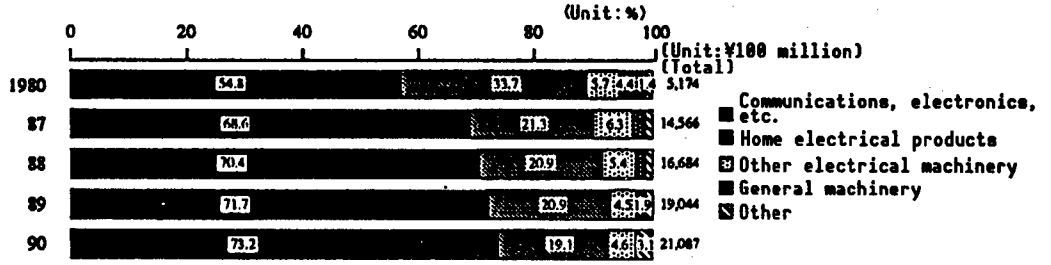
A look at the research expenses of principal industries by the field of their products shows that in many industries there is a tendency for the share of research outlays in the main business to decrease and the outlays for research in fields other than the main business to increase. In the iron and steel industry, in particular, diversification of research is quite noticeable: expenditures for research in the area of iron and steel, which accounted for 79% of total research outlays in FY80, decreased to 50% in FY90. In addition, an increase in the share of outlays for communications, electronics, etc., as afield outside of the main business, is seen in many industries. On the other hand, in contrast to these trends the share of outlays for research in the main business field is steadily expanding in the automobile industry and the communications, electronics, and electrical measuring instruments industry.



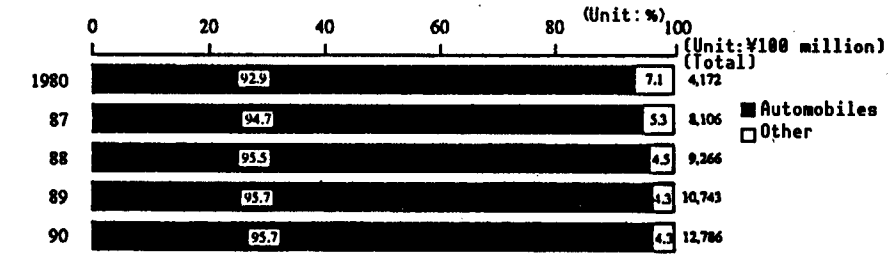
(5) Electrical machinery



(6) Communications, electronics, and electrical measuring instruments



(7) Automobiles



(8) Precision machinery

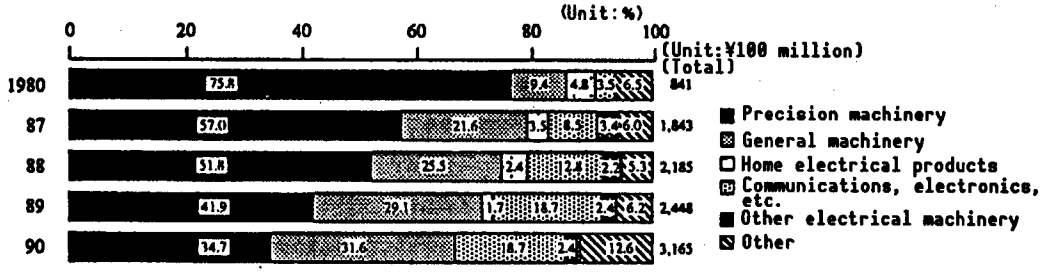
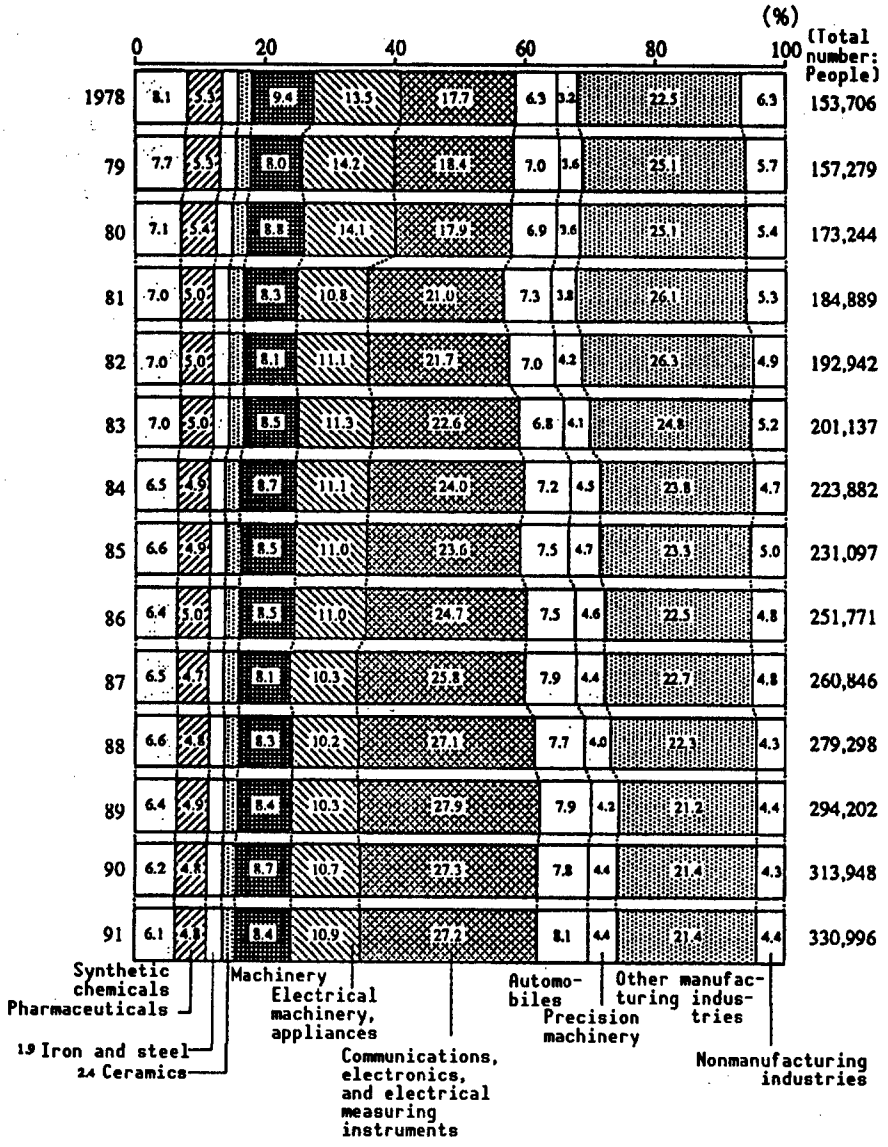


Chart 7-7 Change in Component Ratios of Number of Full-Time Researchers in Japan, by Type of Industry

Looking at the industry-specific number of corporate researchers, we see that the proportions are greatest for the communications/electronics/electrical measuring equipment industry, the electrical-machinery industry, machinery industry, and automobile industry. In these industries, the figure surpasses 50% for the entire industry.



Source: Survey Report of S&T Research (Management and Coordination Agency)

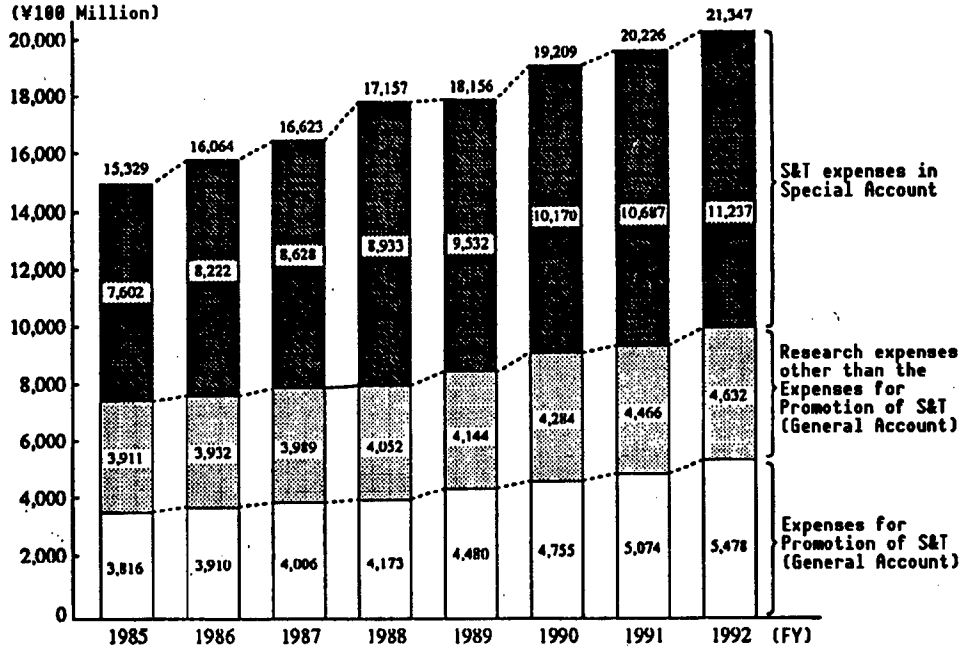
8. Japan's Technology Development Budget

Composition of S&T Budget

- National S&T budget
  - S&T expenses in General Account
    - Expenses for Promotion of S&T:
      A major expense item in the General Account consisting of national laboratory expenditures, various subsidy accounts, etc.
    - Other Research Expenses:
      Consisting of research expenses in the General Account other than the Expenses for the Promotion of S&T (included under other expense items such as the Expenses for Energy Measures, Expenses for Education Assistance, and Measures for Small Business Expenses)
  - S&T expenses in Special Accounts
    Consisting of research expenses in Special Accounts such as the National Schools Special Account, Special Account for Promotion of Electric Power Resources, Oil-Coal Industry and Alternative Energy Special Account, and Industrial Investment Special Account.

Source: Summary of S&T Expenses in FY92 Budget Proposal(Science and Technology Agency)

Chart 8-1 Change in S&T Budgets



Source: Summary of S&T Expenses (Science and Technology Agency)

Chart 8-2 S&T Expenses in FY92 Budget Proposal (Summary by Ministry/Agency (¥1 Million)

Name of ministry or agency	Spending to promote S&T A	Rate of increase over previous year %	Other research-related spending in General Budget B	Rate of increase over previous year %	S&T related spending in General Budget C=A+B	Rate of increase over previous year %	S&T related spending in Special Accounts D	Rate of increase over previous year %	Grand total of S&T related spending C+D	Rate of increase over previous year %
National Diet	536	0.6	–	–	536	0.6	–	–	536	0.6
Science Council of Japan	–	–	1,042	△0.8	1,042	△0.8	–	–	1,042	△0.8
National Police Agency	1,209	5.7	–	–	1,209	5.7	–	–	1,209	5.7
Hokkaido Development Agency	150	1.4	–	–	150	1.4	–	–	150	1.4
Defense Agency	–	–	126,989	10.4	126,989	10.4	–	–	126,989	10.4
Economic Planning Agency	930	9.4	–	–	930	9.4	–	–	930	9.4
Science and Technology Agency	246,208	9.9	165,657	0.0	411,866	5.7	139,912	5.2	551,778	5.6
Environment Agency	11,847	8.7	–	–	11,847	8.7	–	–	11,847	8.7
Ministry of Justice	1,063	5.7	–	–	1,063	5.7	–	–	1,063	5.7
Ministry of Foreign Affairs	–	–	8,251	1.1	8,251	1.1	–	–	8,251	1.1
Ministry of Finance	407	6.6	–	–	407	6.6	1,028	26.7	1,434	20.3
Ministry of Education	84,899	10.9	134,189	2.4	219,088	5.5	773,020	6.1	992,108	6.0
Ministry of Health & Welfare	47,234	11.7	1,864	△13.7	49,098	10.5	12,240	4.6	61,338	9.3
Ministry of Agriculture, Forestry and Fisheries	69,935	3.7	2,942	4.8	72,877	3.7	3,300	0.0	76,177	3.6
MITI	56,205	△0.5	14,066	1.6	70,271	△0.1	188,951	1.8	259,223	1.3
Ministry of Transport	14,436	7.4	6,944	17.2	21,380	10.4	1,135	△0.9	22,515	9.8
Ministry of Posts & Telecom.	5,289	4.3	444	91.4	5,733	8.1	27,000	△5.6	32,733	△3.5
Ministry of Labor	699	3.9	6	1.0	706	3.9	3,082	△29.4	3,787	△24.9
Ministry of Construction	6,150	4.4	786	7.3	6,936	4.7	–	–	6,936	4.7
Ministry of Home Affairs	631	2.4	–	–	631	2.4	–	–	631	2.4
Total	547,829	8.0	463,180	3.7	1,011,009	6.0	1,123,667	5.1	2,134,676	5.5

Notes: 1. Capital for special corporations in S&T budgets within the Industrial Investment Special Account, which is under the jurisdiction of the Ministry of Finance, are appropriated by the ministries and agencies that have jurisdiction over the special corporations. However, there are overlapping tallies for special biological industrial technology research promotion organizations that are jointly run by the Ministry of Agriculture, Forestry and Fisheries, and for the Japan Key Technology Center, which is under MITI and the Ministry of Posts and Telecommunications. (But there are no overlaps in the totals.)

2. This table is based on trial calculations by the Science and Technology Agency.

Source: Summary of S&T Expenses in FY92 Budget Proposal (STA)

Chart 8-3 Table of FY92 National Laboratory Staffs (Relating to Expenses for Promotion of S&T)

Ministry/ agency	Name of organization	Full staff	Research staff
National Police Agency	National Research Institute of Police Science	110	94
Hokkaido Development Agency	Developmental Civil Engineering Institute	213	105
Economic Planning Agency	Economic Research Institute*	79	19
S&T Agency (6 organizations)	National Aerospace Laboratory	438	333
	National Research Institute for Metals	427	330
	National Institute of Radiological Sciences	394	209
	National Institute for Research in Disaster Prevention S&T	117	76
	National Institute for Research in Inorganic Materials	164	118
	National Institute of S&T Policy	46	9
	Total	1,586	1,075
Environment Agency (2 organizations)	National Institute for Environmental Research	274	184
	National Institute for Minamata Disease	27	12
	Total	301	196
Ministry of Justice	Research and Training Institute of the Ministry of Justice*	67	19
Ministry of Finance	National Research Institute of Brewing	37	23
Ministry of Education (6 organizations)	National Institute for Educational Research*	92	71
	National Institute for Special Education*	85	52
	National Science Museum*	151	80
	National Language Research Institute	68	52
	Tokyo National Institute of Cultural Properties*	41	31
	Nara National Institute of Cultural Properties*	86	61
	Total	523	347
Ministry of Health and Welfare (7 organizations)	Institute of Population Problems	36	26
	Institute of Public Health	163	112
	National Institute of Health and Nutrition	46	34
	National Institute of Health	404	312
	Tama National Research Institute	27	18
	National Institute of Medical and Hospital Administration	15	9
	National Institute of Hygienic Science	271	202
	Total	962	713
Ministry of Agriculture, Forestry and Fisheries (29 organizations)	National Agriculture Research Center	325	205
	National Institute of Agrobiological Resources	252	151
	National Institute of Agro-environmental Sciences	226	164
	National Institute of Animal Industry	218	118
	National Grassland Research Institute	212	113
	Fruit Tree Research Station	224	115
	National Research Institute of Vegetable and Tea	288	161
	National Institute of Agro-engineering	111	72
	Hokkaido Agricultural Experiment Station	376	183
	Tohoku Agricultural Experiment Station	353	167
	Hokuriku Agricultural Experiment Station	143	73
	Chugoku Agricultural Experiment Station	220	105
	Shikoku Agricultural Experiment Station	127	66
	Kyushu Agricultural Experiment Station	317	157

[Continued]

[Continuation of Chart 8-3]

Ministry/ agency	Name of organization	Full staff	Research staff
[continued]	National Research Institute of Agricultural Economics	86	51
	National Institute of Sericulture and Insect Agrotechnological Sciences	209	125
	National Institute of Animal Health	309	151
	National Food Research Institute	140	111
	Tropical Agriculture Research Center	145	106
	National Forest Research Institute	750	500
	Hokkaido Regional Fisheries Research Laboratory	86	26
	Tohoku Regional Fisheries Research Laboratory	69	39
	Central Regional Fisheries Research Laboratory	170	93
	Southwest Sea Regional Fisheries Research Laboratory	77	48
	West Sea Regional Fisheries Research Laboratory	84	40
	Japanese Sea Regional Fisheries Research Laboratory	65	24
	Long-Distance Fisheries Regional Fisheries Research Laboratory	103	56
	National Research Institute of Aquaculture	93	60
	National Research Institute of Fisheries Engineering	63	43
	Total	5,841	3,323
MITI (16 organizations)	National Research Laboratory of Metrology	213	124
	Mechanical Engineering Laboratory	273	214
	National Chemical Laboratory for Industry	343	269
	Government Industrial Research Institute, Osaka	215	164
	Government Industrial Research Institute, Nagoya	232	178
	Fermentation Research Institute	89	71
	Research Institute for Polymers and Textiles	124	101
	Geological Survey of Japan	343	233
	Electrotechnical Laboratory	676	544
	Industrial Products Research Institute	124	101
	Research Institute of Resource and Environmental Sciences	306	235
	Government Industrial Development Laboratory, Hokkaido	96	73
	Government Industrial Research Institute, Kyushu	90	69
	Government Industrial Research Institute, Shikoku	47	37
	Government Industrial Research Institute, Tohoku	54	39
	Government Industrial Research Institute, Chugoku	51	39
	Research Institute of Materials Engineering (provisional name)	0	0
	Research Institute of Bioengineering (provisional name)	0	0
	Research Institute of Industrial S&T (provisional name)	0	0
	Total	3,276	2,491
Ministry of Transport (5 organizations)	Ship Research Institute	260	191
	Electronic Navigation Research Institute	37	30
	Port and Harbor Research Institute	183	139
	Traffic Safety and Nuisance Research Institute	57	49
	Meteorological Research Institute	180	145
	Total	717	554
Ministry of Posts & Telecommunications	Communications Research Laboratory	422	283
Ministry of Labor (2 organizations)	Industrial Safety Institute	35	26
	National Institute of Industrial Health	35	27
	Total	70	53
Ministry of Construction (2 organ.)	Public Works Research Institute	283	192
	Building Research Institute	172	117
	Total	455	309
Ministry of Home Affairs	Fire Research Institute	52	35
	Total (82 organizations)	14,711	9,639

[Notes to Chart 8-3]

Notes: 1. "Full staff" and "research staff" are the numbers of people on the staffs in the budget at the end of FY92. However, the numbers for MITI staffs are the numbers of people of the staffs the end of December 1992.
2. Organizations indicated with asterisks are cultural science organizations. As of December 1992, there are 74 natural sciences organizations with 14,042 people (of which 9,254 are research staff). There are 8 cultural science organizations with 669 people (of which 385 are research staff).

Source: Summary of S&T Expenses in FY92 Budget Proposal (Science and Technology Agency)

Chart 8-4 Summary of FY92 MITI Technology Development Budget

(Unit: ¥100 million)

Item	FY91 budget	FY92 budget	A	B
Total budget related to new technology development	2,559	2,592	33	1.3%
General Account	703	703	Δ0.4	Δ0.1%
Special Account (except Industrial Investment S/A)	1,546	1,623	76	4.9%
Industrial Investment Special Account	310	267	Δ43	Δ14%
1. Maintaining system for promoting international creativity and exchange in S&T				
(1) Augmenting the functions of the Tsukuba Science Center				
- Strengthen research in multidisciplinary areas	0	1.5	1.5	
- Setting up places for multidisciplinary research exchange among industry, government, universities	4.1	18	14	
- Research expenses, etc. of national laboratories (special research, joint government private research, operating expenses for laboratories, etc.)	130	130	0.0	
(2) Strengthening the foundation for activities in basic, advanced research				
- NEDO research base maintenance enterprise	24 (24)	7 (7)	Δ17	
2. Promoting international research exchange				
- Human frontier science program	15 -	16 -	0.4	
- International joint research assistance enterprise	4.6 -	6.8 (1.3)	2.2	
- International research exchange enterprise	2.2 -	2.2 -	Δ0.1	
- International joint research and research cooperation	7.5 (3.0)	8.1 (3.4)	0.5	
- IMS (intelligent manufacturing system) international research program	2.7 (1.5)	7.6 (5.8)	4.9	
- International joint development of aircraft	70 (27)	83 (35)	14	
- Development of unmanned space experiment system	99 (95)	121 (118)	22	
3. Active promotion of R&D				
(1) Promoting the development of common, basic technology for the progress of humankind				
- R&D of basic technologies for future industries	79 (50)	82 (58)	3.0	
- R&D of large-scale industrial technologies	143 (110)	147 (121)	3.9	
- R&D of biofunction-application industrial technologies	3.0 -	2.6 -	Δ0.4	
- Base maintenance and technology development relating to DNA analysis	0 -	0.8 (0.8)	0.8	
- Funding for the Japan Key Technology Center	286 (286)	260 (260)	Δ26	
(2) Promoting the development of environmental and energy technologies				
- Development of global environmental technologies (national laboratories, RITE, etc.)	57 (50)	66 (58)	9	
Within third-generation freon development	11 (11)	12 (12)	1.0	
- R&D of new energy technologies (Sunshine Program)	248 (240)	265 (258)	17	
- R&D of energy-conservation technologies (Moonlight Program)	115 (112)	118 (115)	3.1	
- Development, application of energy-related tech.	21 (21)	20 (20)	Δ0.8	
- Development of technology for utilizing unused energy	4 (4)	8.5 (8.5)	4.5	
- Develop. of nuclear-power related technology, etc.	271 (271)	270 (270)	Δ1.9	
(3) Promoting the development of technology for realizing relaxed lifestyles and affluence				
- Regional technology R&D	2.8 -	3.7 (0.8)	0.9	
- R&D of medical and health-care equipment	6.9 -	6.9 -	Δ0.1	
- Development of technology for serving and regenerating resources	1.6 (1.6)	5.3 (5.3)	3.7	
- Development of technology as a measure for ensuring manpower in small and medium-size businesses	6.1 -	6.1 -	0.0	
(4) Promoting informationalization				
- Fifth-generation computers	72 (41)	36 (26)	Δ37	
- Development of new information processing tech.	1.0 -	8.8 (6.4)	7.8	

A: Change over previous year; B: Rate of change over previous year
Figures within parentheses show the portions from Special Accounts.

Reference Table 1. R&D Expenses of Major Japanese and U.S. Firms

1. Japan (Ranking based on FY91 results)

(Unit: 100 million yen)

Rank	Name of company	FY90	FY91	
		R&D expenses	R&D expenses	(% of sales)
1	Toyota Motor Corporation	4,300	4,500	(5.00)
2	Matsushita Electric Co., Ltd.	*3,839	*4,320	(8.71)
3	Hitachi, Ltd.	3,919	4,100	(10.38)
4	Fujitsu Ltd.	2,919	3,250	(13.00)
5	NEC Corporation	3,000	3,200	(10.22)
6	Toshiba Corporation	2,653	2,800	(8.43)
7	NTT	2,618	2,800	(4.58)
8	Nissan Motor Co., Ltd.	2,350	2,500	(5.81)
9	Mitsubishi Electric Corporation	1,830	1,900	(7.14)
10	Mitsubishi Heavy Industries, Ltd.	1,122	1,293	(5.28)
11	Mitsubishi Motors Corporation	1,060	1,200	(4.90)
12	Canon Inc.	983	1,100	(10.09)
13	Mazda Motor Corporation	1,053	1,050	(4.49)
14	Sharp Corporation	894	980	(8.03)
15	Nippondenso Co., Ltd.	905	880	(6.57)
16	Sanyo Electric Co., Ltd.	695	770	(6.55)
17	The Tokyo Electric Power Co., Ltd.	598	678	(1.47)
18	Matsushita Communication Industrial Co., Ltd.	528	595	(12.66)
19	Isuzu Motor, Ltd.	512	590	(4.86)
20	Ricoh Co., Ltd.	544	584	(8.53)
21	Takeda Chemical Industries, Ltd.	494	558	(9.79)
22	Asahi Chemical Industry Co., Ltd.	440	480	(4.78)
23	Bridgestone Corporation	430	460	(6.30)
"	Sumitomo Metal Industries, Ltd.	377	460	(3.93)
"	Oki Electric Industry Co., Ltd.	444	460	(7.67)
26	Matsushita Electric Works, Ltd.	383	440	(4.31)
27	Asahi Glass Co., Ltd.	400	430	(4.17)
28	Kobe Steel,Ltd.	397	420	(3.17)
29	Victor Company of Japan, Ltd.	393	415	(6.34)
30	Komatsu, Ltd.	401	414	(6.57)
31	Mitsubishi Chemical Industries, ltd.	400	410	(5.39)
32	Sumitomo Chemical Co., Ltd.	372	400	(5.63)
33	Ishikawajima-Harima Heavy Industries Co., Ltd.	332	373	(4.66)
34	Hino Motors, Ltd.	324	340	(5.34)
35	Omron Co., Ltd.	293	330	(8.05)
36	Toray Industries, Inc.	301	325	(5.33)
37	Fuji Electric Co., Ltd.	320	324	(4.98)
38	Kao Corporation	281	300	(5.08)
"	Fujisawa Pharmaceutical Co., Ltd.	276	300	(12.93)
"	Eisai Co., Ltd.	294	300	(14.22)
"	Fuji Heavy Industries, Ltd.	285	300	(3.61)
42	Sankyo Co., Ltd.	248	293	(8.25)
43	Shionogi & Co., Ltd.	245	289	(12.84)
44	Kubota, Ltd.	259	280	(3.78)
45	Sekisui Chemical Co., Ltd.	231	279	(4.27)
46	Daihatsu Motor Co., Ltd.	228	275	(3.50)
47	Sumitomo Electric Industries, Ltd.	250	270	(3.33)
48	Olympus Optical Co., Ltd.	233	255	(13.64)
49	TDK Corporation	232	250	(5.95)
50	Konica Corporation	226	242	(6.23)

Note: A Toyo Keizai investigation. In principal, excludes finance and insurance, trading companies, and retailers. Asterisks indicate consolidation-based figures.

Source: Toyo Keizai (Monthly Statistics Report, March 1992)

2. United States (1991)

Rank	Name of company	Research expenses		(% of sales)
		Million dollars	¥100 million	
1	International Business Machines	6,644	8,949	10
2	American Telephone & Telegraph	2,433	3,277	7
3	E I DuPont de Nemours & Company	1,988	2,678	5
4	Digital Equipment Corporation	1,649	2,222	12
5	Eastman Kodak Company	1,494	2,012	8
6	Hewlett Package Company	1,463	1,971	10
7	Dow Chemical Company	1,136	1,530	6
8	United Technologies Corporation	1,021	1,376	5
9	Exxon Corporation	957	1,289	1
10	Bristol Myers Squibb Company	881	1,187	9
11	Merck & Company Inc.	854	1,150	11
12	Johnson & Johnson	834	1,123	7
13	Unisys Corporation	747	1,006	7
14	Eli Lilly & Company	703	947	14
15	Amoco Corporation	693	933	2
16	Monsanto Company	692	932	8
17	Mobil Corporation	686	924	1
18	Abbott Laboratories	666	898	10
19	Shell Oil Company	665	896	3
20	Chevron Corporation	642	865	2
21	Pfizer Inc.	640	862	10
22	Amoco Company	604	814	2
23	Apple Computer Inc.	583	785	9
24	Inter Corporation	517	696	13
25	NCR Corporation	502	676	8
26	Texaco Inc.	499	672	1
27	American Cyanamid Company	461	620	10
28	McDonnell Douglas Corporation	450	606	2
29	UpJohn Company	427	575	14
30	Schering Plough Corporation	380	511	11
31	Warner Lambert Company	379	511	8
32	Schlumberger Nv.	373	502	7
32	Schlumberger Ltd.	373	502	7
34	Marion Merrell Dow Inc.	358	482	15
35	Sun Microsystems Inc.	357	480	11
36	Rhone Poulene Rorer Inc.	350	472	12
37	Amerada Hess Corporation	333	448	5
38	Syntex Corporation	316	425	17
39	Amdahl Corporation	310	418	14
40	Unocal Corporation	309	416	3
40	Union Oil Company of California	309	416	3
40	TRW Inc.	309	416	4
43	Phillips Petroleum Company	299	403	2
44	Honeywell Inc.	280	377	4
45	Deere & Company	279	376	4
46	Caterpillar Inc.	272	366	3
47	Raytheon Company	268	360	3
48	Tandem Computers Inc.	267	359	14
49	Baxter International Inc.	261	352	3
50	Scott Paper Company	258	347	5

Source: DIALOG (DISCLOSURE)

Reference Table 2. Number of Patent Acquisitions in the United States by Principal Firms

	1976			1987		
	Enterprise	Country	Cases	Enterprise	Country	Cases
1	GE	Japan	802	Canon	Japan	847
2	U.S. Navy	U.S.	631	Hitachi	Japan	845
3	Bayer	Germany	555	Toshiba	Japan	823
4	Xerox	U.S.	548	GE	U.S.	779
5	Siemens	Germany	488	Phillips	U.S.	687
6	IBM	U.S.	480	Westinghouse	U.S.	652
7	Phillips	U.S.	469	IBM	U.S.	591
8	Westinghouse	U.S.	458	Siemens	Germany	539
9	Dupont	U.S.	457	Mitsubishi Electric	Japan	518
10	RCA	U.S.	423	RCA	U.S.	504
11	U.S. Army	U.S.	417	Fuji Film	Japan	494
12	GM	U.S.	402	Dow Chemical	U.S.	469
13	Ciba Geigy	Germany	399	DuPont	U.S.	419
14	Hoechst	Germany	347	Motorola	U.S.	414
15	Hitachi	Japan	340	AT&T	U.S.	406
16	Caterpillar	U.S.	340	Honda Motor	Japan	395
17	AT&T	U.S.	334	NEC	Japan	375
18	Phillips Petroleum	U.S.	296	Toyota Motor	Japan	375
19	Dow Chemical	U.S.	293	Bayer	Germany	371
20	ICI	U.S.	290	GM	U.S.	370

[Continued]

[Continuation of Reference Table 2]

	1988			1989		
	Enterprise	Country	Cases	Enterprise	Country	Cases
1	Hitachi	Japan	907	Hitachi	Japan	1,053
2	Toshiba	Japan	750	Toshiba	Japan	961
3	Canon	Japan	723	Canon	Japan	949
4	GE	U.S.	690	Fuji Film	Japan	884
5	Fuji Film	Japan	589	GE	U.S.	818
6	Phillips	U.S.	581	Mitsubishi Electric	Japan	767
7	Siemens	Germany	562	Phillips	U.S.	745
8	IBM	U.S.	549	Siemens	Germany	656
9	Mitsubishi Electric	Japan	543	IBM	U.S.	623
10	Bayer	Germany	442	Kodak	U.S.	589
11	Westinghouse	U.S.	435	NEC	Japan	480
12	Kodak	U.S.	433	Bayer	Germany	468
13	Dow Chemical	U.S.	421	Westinghouse	U.S.	452
14	GM	U.S.	383	DuPont	U.S.	443
15	DuPont	U.S.	375	Dow Chemical	U.S.	431
16	AT&T	U.S.	372	GM	U.S.	412
17	Honda Motor	Japan	364	TI	U.S.	400
18	NEC	Japan	353	Motorola	U.S.	384
19	Motorola	U.S.	341	AT&T	U.S.	381
20	Sony	Japan	300	3M	U.S.	381

[Continued]

[Continuation of Reference Table 2]

	1990			1991		
	Enterprise	Country	Cases	Enterprise	Country	Cases
1	Hitachi	Japan	908	Toshiba	Japan	1,014
2	Toshiba	Japan	891	Mitsubishi Electric	Japan	936
3	Canon	Japan	868	Hitachi	Japan	927
4	Mitsubishi Electric	Japan	862	Kodak	U.S.	863
5	GE	U.S.	785	Canon	Japan	823
6	Fuji Film	Japan	767	GE	U.S.	809
7	Kodak	U.S.	720	Fuji Film	Japan	731
8	Phillips	U.S.	637	IBM	U.S.	679
9	IBM	U.S.	608	Phillips	U.S.	650
10	Siemens	Germany	506	Motorola	U.S.	613
11	Bayer	Germany	499	DuPont	U.S.	596
12	DuPont	U.S.	481	Bayer	Germany	492
13	NEC	Japan	436	AT&T	U.S.	484
14	Westinghouse	U.S.	435	Siemens	Germany	474
15	AT&T	U.S.	429	Matsushita Electric Industrial	Japan	455
16	Ciba Geigy	Germany	409	GM	U.S.	437
17	Dow Chemical	U.S.	400	NEC	Japan	427
18	Motorola	U.S.	394	Ciba Geigy	Germany	414
19	BASF	Germany	394	Sharp	Japan	384
20	GM	U.S.	379	BASF	Germany	383

Source: NTIS "Industrial Patent Activity in United States"

Reference Table 3. Immigration of S&T-Related People

(a) Entries into Japan

Year	1985			1986			1987			1988			1989			1990		
Unit	People	%	People	People	%	People	People	%	People	People	%	People	People	%	People	People	%	People
Total No.	38,801	100		43,687	100		53,103	100		68,304	100		84,295	100		104,572	100	
Asia	29,369	75.7		33,485	76.7		41,621	78.4		55,617	81.0		67,248	80.0		86,163	82.4	
	China		11,752	China		10,337	China		11,974	China		15,167	China		20,286	China		23,406
	Korea		7,453	Korea		9,438	Korea		10,874	Korea		13,083	Korea		15,015	Korea		21,172
	Taiwan		1,309	Taiwan		4,965	Taiwan		7,235	Taiwan		10,638	Taiwan		3,425	Taiwan		16,642
Europe	2,487	6.4		2,796	6.4		3,383	6.3		3,807	5.6		4,640	5.5		5,674	5.4	
	U.K.		1,017	U.K.		1,124	U.K.		1,304	U.K.		1,458	U.K.		1,765	U.K.		1,920
	France		416	France		445	France		579	France		694	France		747	France		834
	W. Germany		340	W. Germany		382	W. Germany		499	W. Germany		542	W. Germany		618	W. Germany		718
Africa	1,310	3.4		952	2.2		1,053	2.0		1,078	1.6		1,321	1.6		1,407	1.3	
N.America	3,821	9.8		4,348	9.9		4,814	9.0		5,271	7.7		6,255	7.4		7,612	7.3	
	U.S.		3,205	U.S.		3,633	U.S.		4,124	U.S.		4,468	U.S.		5,252	U.S.		6,242
	Canada		270	Canada		329	Canada		324	Canada		395	Canada		440	Canada		676
S.America	1,302	3.4		1,492	3.4		1,621	3.1		1,844	2.7		3,961	4.7		2,799	2.7	
Oceania	445	1.1		505	1.2		531	1.0		590	0.9		798	0.9		871	0.8	
Stateless	67	0.2		109	0.2		80	0.2		97	0.1		72	0.1		46	0.0	

Note: S&T-related people entering Japan signifies [those who come to Japan] for study abroad," "training," "education," "academic activities," or "supplying" technology.

(b) Departures from Japan

Year	1985			1986			1987			1988			1989			1990		
Unit	People	%	People	People	%	People	People	%	People	People	%	People	People	%	People	People	%	People
Total No.	41,123	100		55,869	100		81,407	100		113,632	100		146,488	100		185,888	100	
Asia	7,652	18.6		11,239	20.1		17,838	21.9		24,971	22.0		30,225	21.0		39,095	21.0	
	China		3,184	China		4,402	China		6,789	China		9,341	China		8,606	China		16,188
	Korea		1,253	Korea		1,987	Korea		3,185	Korea		4,499	Korea		6,152	Korea		6,873
	Taiwan		1,088	Taiwan		1,654	Taiwan		2,687	Taiwan		3,573	Taiwan		4,644	Taiwan		4,209
Europe	10,697	26.0		14,337	25.7		20,548	25.2		27,185	23.9		34,287	23.4		41,622	22.4	
	U.K.		3,021	U.K.		4,367	U.K.		7,479	U.K.		10,487	U.K.		13,511	U.K.		17,094
	France		2,153	France		2,824	France		3,675	France		4,733	France		6,123	France		6,595
	W. Germany		2,151	W. Germany		2,770	W. Germany		3,627	W. Germany		4,546	W. Germany		5,555	W. Germany		5,826
Africa	182	0.4		262	0.5		384	0.5		418	0.4		490	0.3		334	0.2	
N.America	21,374	52.0		28,051	50.2		39,270	48.2		56,088	49.4		74,554	50.9		95,855	51.6	
	U.S.		20,069	U.S.		26,334	U.S.		36,937	U.S.		52,224	U.S.		69,556	U.S.		88,395
	Canada		1,044	Canada		1,503	Canada		2,116	Canada		3,629	Canada		4,743	Canada		7,255
S.America	183	0.4		303	0.5		337	0.5		458	0.4		592	0.4		629	0.3	
Oceania	1,035	2.6		1,677	3.0		3,030	3.7		4,512	3.9		6,340	4.4		8,319	4.5	
Other	0	0		0	0		0	0		0	0		0	0		34	0.0	

Note: S&T-related people departing from Japan signifies [those who leave Japan] for "scientific research or studies," or "study abroad, training, or acquiring technology."

Source: Yearly Report of Immigration Statistics (Ministry of Justice)

Reference Table 4. Appointment of Non-Japanese Public-Service Research Personnel, and Public Servants' Participation in Research Meetings (Academic Societies) in Foreign Countries Due to Research Exchange Promotion Act

(1) Appointment of Non-Japanese Public-Service Research Personnel

Ministry or agency	No. of people	Affiliated organization	Nationality	Period
Science and Technology Agency	3	National Research Institute for Metals " National Institute of S&T Policy	U.S. Korea U.S.	2 years 3 years 2 years
Ministry of Health and Welfare	2	Saitama National Hospital National Center for Mental Health and Neurology	U.S. Korea	- -
Ministry of Agriculture, Forestry and Fishery	1	National Institute of Sericulture and Insects	Brazil	3 years
MITI	3	Mechanical Engineering Laboratory Geological Survey of Japan Electrotechnical Laboratory	U.K. U.S. India	3 years 3 years 3 years
Ministry of Posts and Telecommunications	4	Communications Research Laboratory " " "	Iran China China Korea	2 years 3 years 3 years 3 years
Total	13			

(2) Public Servants' Participation in Research Meetings (Academic Societies) in Foreign Countries

Ministry or agency	Cumulative No. of participants	Main destinations
National Police Agency	49	United States, Australia, etc.
Hokkaido Development Agency	6	Switzerland, China, etc.
Ministry of Defense	43	United States, Germany, etc.
Science and Technology Agency	418	United States, United Kingdom, etc.
Environment Agency	132	United States, Germany, etc.
Ministry of Health and Welfare	492	United States, Germany, etc.
Ministry of Agriculture, Forestry and Fisheries	600	United States, Canada, etc.
MITI	1,047	United States, Germany, etc.
Ministry of Transport	164	United States, China, etc.
Ministry of Posts and Telecommunications	63	United States, Canada, etc.
Ministry of Labor	14	United States, Canada, etc.
Ministry of Construction	103	United States, United Kingdom, etc.
Ministry of Home Affairs	6	United Kingdom, USSR, etc.

Both (1) and (2) show totals for up until 1 July 1991.

Notes: • The Research Exchange Promotion Act was enacted in 1986 for the purpose of promoting the exchange of Japanese and non-Japanese persons in connection with Japan's scientific and technical research.
(1) With respect to the appointment of foreigners as public-service research personnel, non-Japanese people can be appointed to public-service research positions up to the class of research section chief, and, in that case, they can be employed for a specified term of appointment.
(2) With respect to the participation of public servants in research meetings (academic societies) overseas, in order to facilitate public servants' participation in research meetings (academic societies), this law enables participation at one's own expense in academic societies, etc., depending on one's exemption from his or her professional duties.

Reference Data 1. Definition of High-Technology

Example 1. High-Technology Industries (OECD Definition): This means industries in which R&D is actively carried out (high R&D intensive industries). In classifying the different types of industries, the judgment criterion is the strength of R&D outlays (R&D outlays/production yield). The following table shows the OECD high-tech industries.

1970		1980	
	(Strength of R&D outlays) %		(Strength of R&D outlays) %
1. Aerospace	25.6	1. Aerospace	22.7
2. Business machines, computers	13.4	2. Business machines, computers	17.5
3. Electronics & components	8.4	3. Electronics & components	10.4
4. Pharmaceuticals	6.4	4. Pharmaceuticals	8.7
5. Precision machinery	4.5	5. Precision machinery	4.8
6. Electronic equipment	4.5	6. Electronic equipment	4.4
	Average 10.4		Average 11.4

Source: OECD Science and Technology Indicators - R&D, Invention and Competitiveness - (1986)

Example 2. High-Technology Products (U.S. Department of Commerce Definition): High-tech product groups are as follows.

1. Guided missiles and spacecraft
2. Communications equipment and electronics components
3. Aircraft and parts
4. Office equipment and computers
5. Weapons and accessories
6. Pharmaceuticals
7. Inorganic chemical products
8. Professional and scientific instruments
9. Engines, turbines, and parts
10. Plastic materials, synthetic resins, rubber, and fibers

Source: U.S. High-Tech Trade and Competitiveness, February 1985 (U.S. Department of Commerce)

Reference Data 2. OECD Full-Time Equivalent for R&D Data

Japan's R&D index data that relate to people are different from that of other countries; in Japan, the numbers of people employed as researchers in research departments and the numbers of people employed as staff are counted. According to the Frascati Manual that forms the basis of the concepts and methods of OECD R&D surveys, the number of people engaged in R&D are supposed to be counted using the full-time equivalent. If we restrict ourselves to Japan's national laboratories, industry, and private nonprofit groups, it is thought that the Japanese way of counting researchers can be permitted for the purpose of international comparison. The reason is that most of the people associated with those categories are thought to be engaged in R&D on a full-time basis. However, insofar as the category of high-level education, that assumption does not apply. According to the data on 10 countries of various scales, university professors engaged in R&D usually do not spend more than half of their time on R&D activities, but rather spend their time in nonscientific areas. The remaining half of their time is spent on teaching preparation, lectures, meetings, conferences, and participation in administrative activities. For these reasons, it is thought that corrections should be made to the R&D data for Japan's high-level education category. (Furthermore, that correction will affect the overall data.)

The conditions and the results of correcting the R&D data areas follows.

High-Level Education Category; Source of Funding and Number of Researchers (1981)

	Published data	Correction factor	Corrector value
Source of funding (¥1 billion)			
From industry	14.1	1.0	14.1
From public departments			
—Direct from government	163.5	1.0	163.5
—Universities' funds on hand	671.1	0.6	402.7
—Total from public departments	834.6	—	566.2
Private universities' funds on hand	596.2	0.6	357.7
From special corporations	0.7	1.0	0.7
From overseas	0.1	1.0	0.1
High-level education's total R&D outlays	1,445.7	—	938.8
Number of researchers	104,112	0.5	52,056

Source: OECD Science and Technology Indicators - R&D, Invention and Competitiveness - (1986)

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